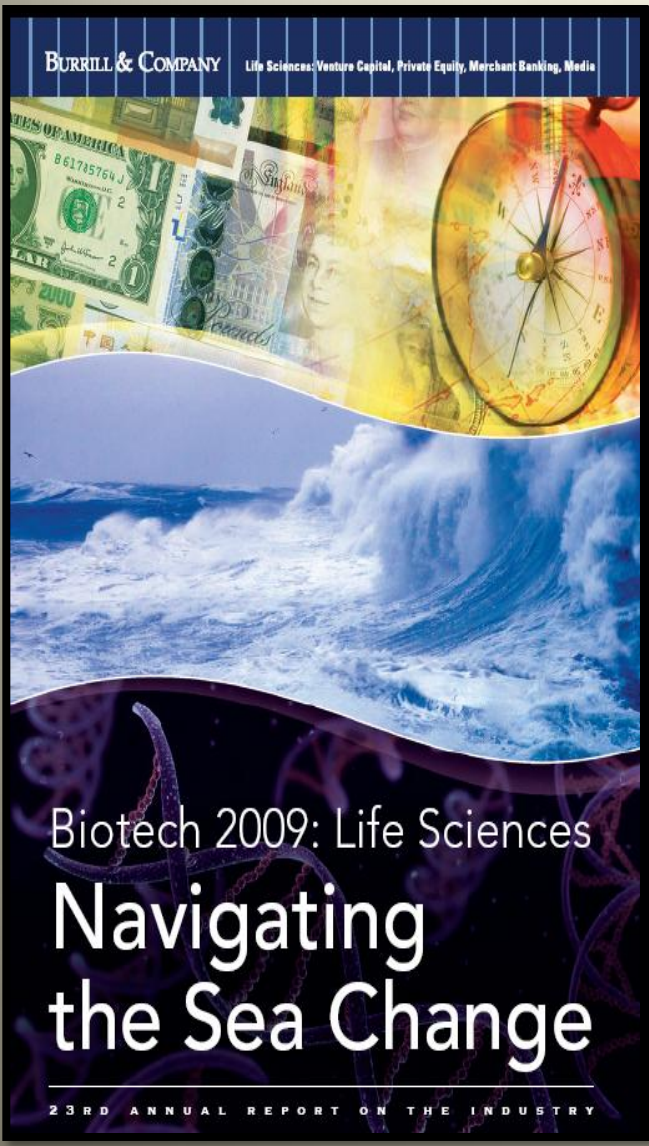
ASU Complex Adaptive Systems Initiative
Arizona State University

Burrill & Company
Life Sciences: Venture Capital, Private Equity, Merchant Banking, Media

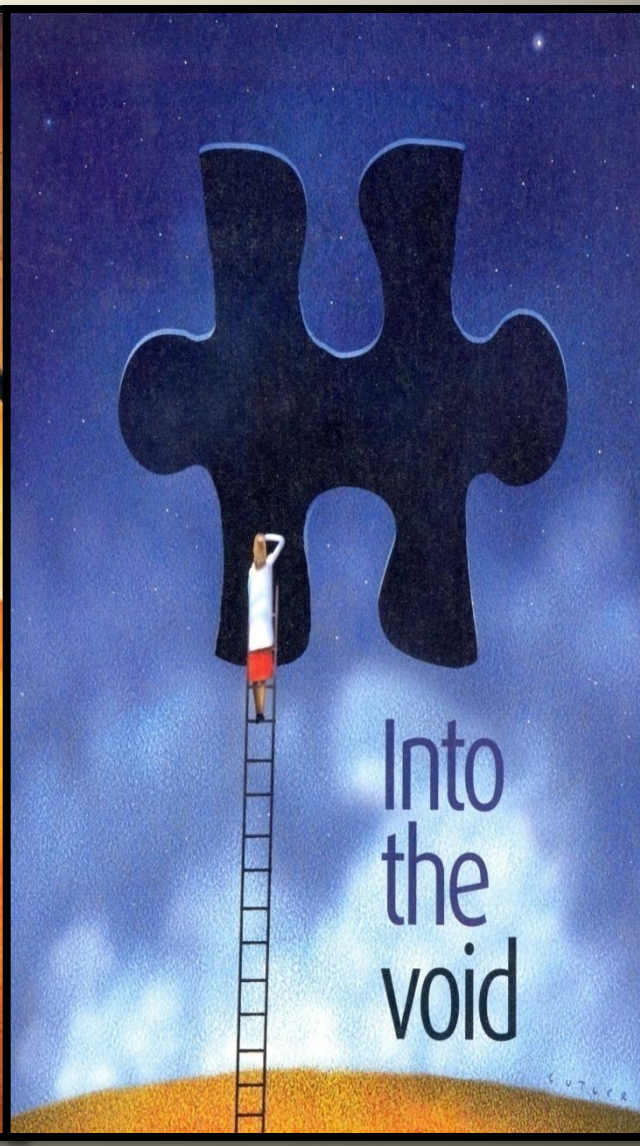
Technology Acceleration and Technology Convergence: Where Is It Taking Us?

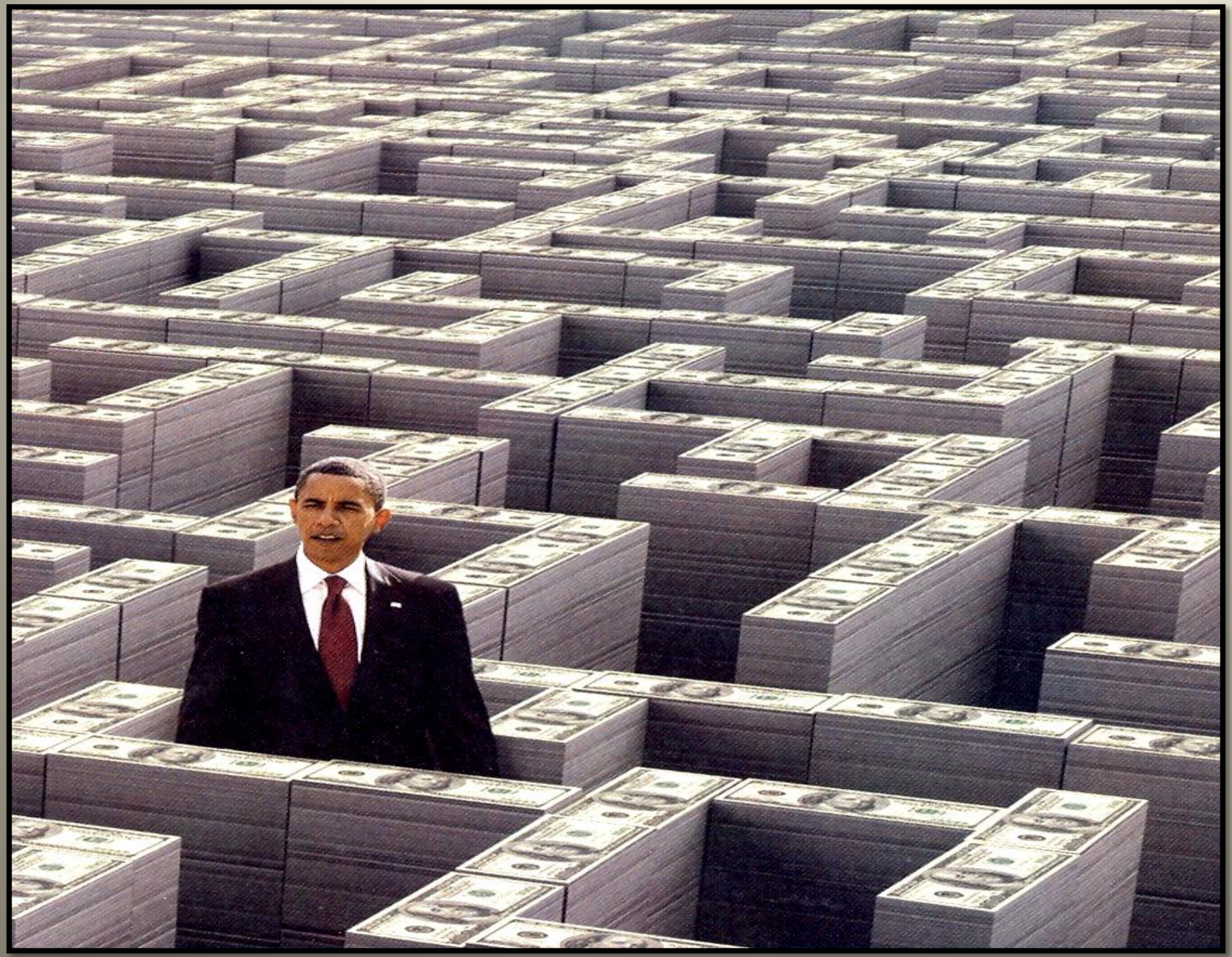
Dr. George Poste, Chief Scientist,
Complex Adaptive Systems Initiative
Arizona State University
george.poste@asu.edu

Presentation at Burrill and Company,
Limited Partners and Advisory Board Meeting
Sausalito, CA
28 April 2009


BURRILL & COMPANY
Life Sciences: Venture Capital, Private Equity, Merchant Banking, Media
Biotech 2009: Life Sciences
Navigating the Sea Change
23RD ANNUAL REPORT ON THE INDUSTRY


EXIT CLOSED
Sand Hill Road
No IPOs


Into the void



Navigating The Sea Change

- adapting to new realities
- define new value propositions
- cost control and cost avoidance
- improved health outcomes
- integrated care of complex chronic diseases
- customized care and the path to personalized medicine

Navigating The Sea Change

Mastery of Convergence

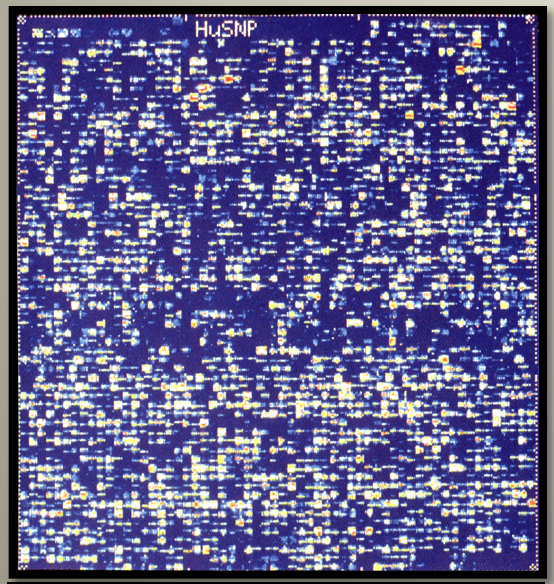
- technological
  - biotechnology, engineering and computing
- clinical
  - diagnostics (Dx), imaging (Ix), therapeutics (Rx), devices and healthcare information (HIx)
- commercial
  - integration of Dx; Rx and HIx
- strategic alliances
  - new ecosystem of corporate linkages for horizontal integration

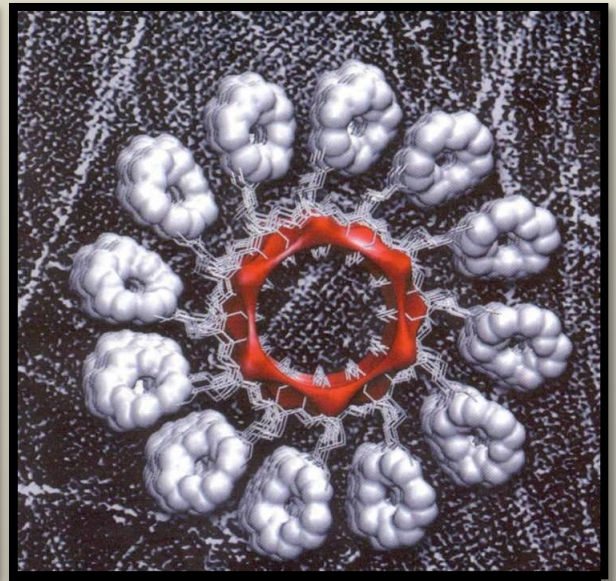
The Conceptual Foundations of Drug Discovery

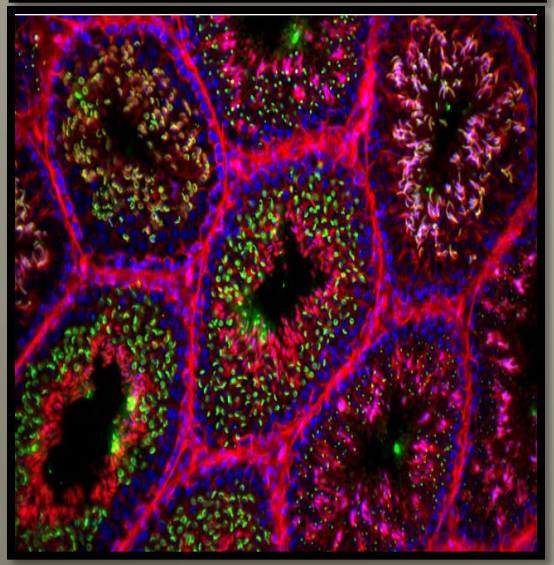
- understanding biological systems and the perturbations causing disease

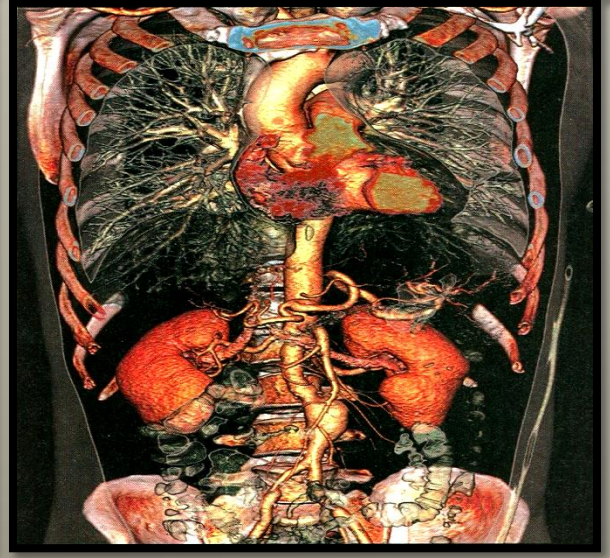
Biological Design: “Endless Forms Most Beautiful”: Limitless Diversity From Combinatorial Assemblies of Limited Building Blocks

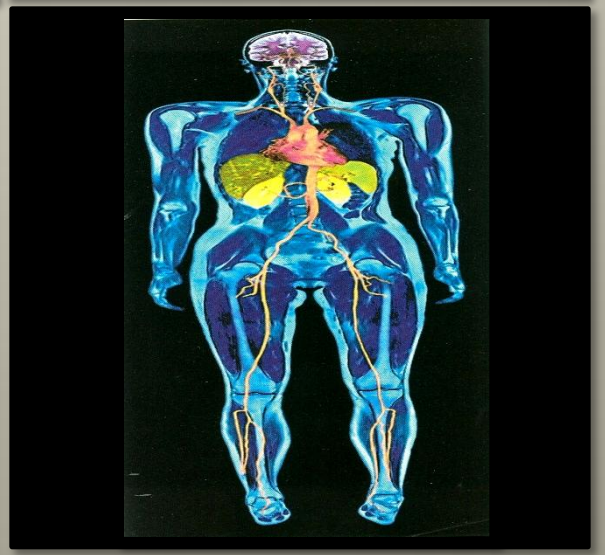
Systems Biology:
Mapping The Design of Complex, Adaptive Networks of Increasingly Higher Structural Order







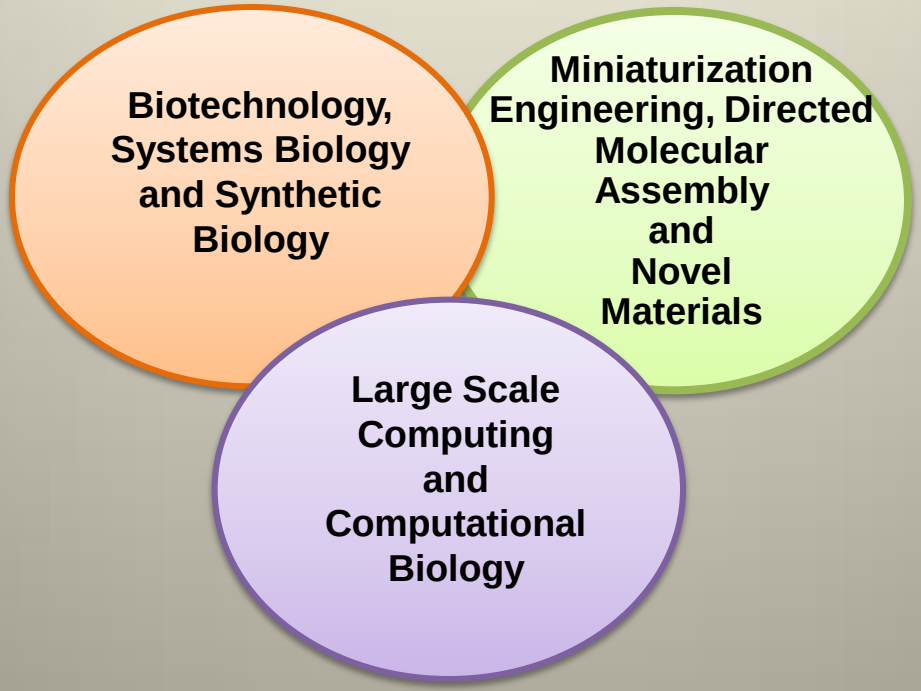




21st Century Science: Comprehending Biological Design

"SYSTEMS and SYNTHETIC BIOLOGY"

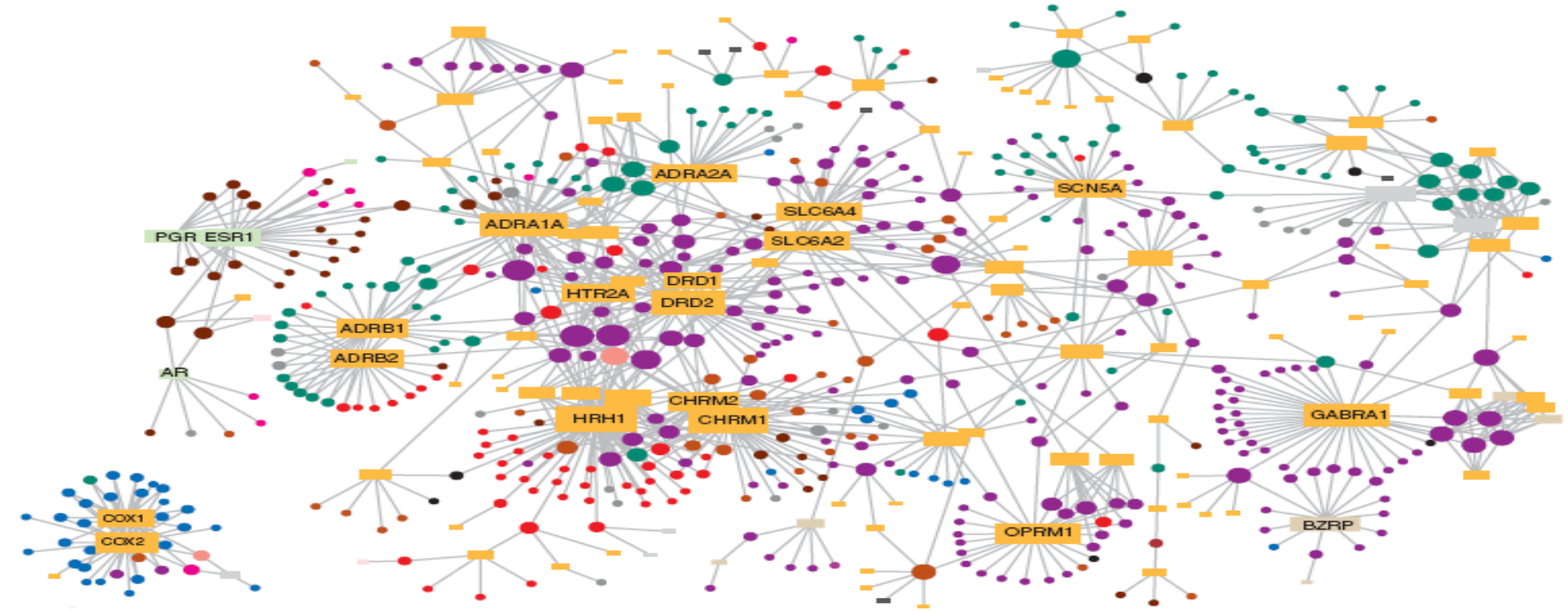
- the design principles of biological order and complexity
- the information content of biopathways and networks
- engineering bio-inspired novel functions and life forms



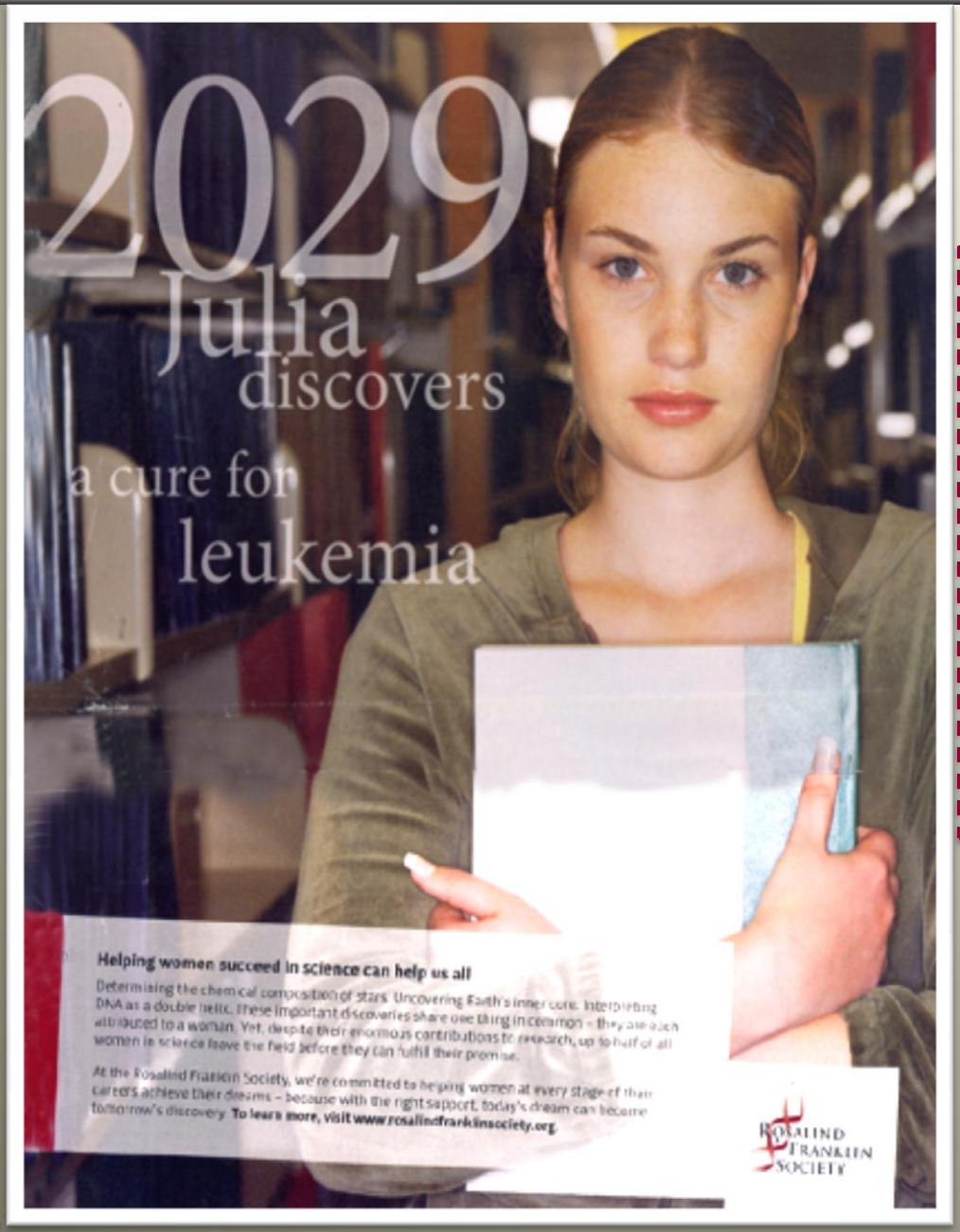
"TECHNOLOGY CONVERGENCE"

The Conceptual Foundations of Drug Discovery

- from empiricism to rational therapeutics
- from ambiguity to predictability
  - mechanism(s) of action
  - clinical efficacy and safety
  - healthcare outcomes and value



Drug-Target Networks for FDA Approved Rx



Major Constraints in Drug Discovery

Major Constraints in Drug Discovery:

Inadequate Knowledge of Biological Networks

- accuracy of Rx target selection and causal relationship to disease
- network redundancy and circumvention/resistance to Rx action
- increasing evidence of importance of multi-focal ‘promiscuous’ Rx action for optimum efficacy

Major Constraints in Drug Discovery:

Inadequate Knowledge of Biological Networks

- imprecise knowledge of the causality of complex traits and disease-associated disruptions
- complex interplay of multiple low-penetrance alleles
- complex relationships
  - variation in genotype
  - variation in gene expression
  - variation in disease phenotype(s)

Major Constraints in Drug Discovery:

Inadequate Profiling of Patients for Clinical Trials

- "all comers" versus enrichment with patient cohort(s) with molecular pathology relevant to Rx action
- unique problem in oncology clinical trials of testing in Rx-failure patients
- urgent imperative for biomarkers/Dx tests for identification of 'relevant' patient cohorts and adaptive clinical trial design

Major Constraints in Drug Discovery:

Risk Aversion and the Elusive Quest for Zero-Risk

- safety profiling in small ‘N’ populations in clinical trials will not identify idiosyncratic adverse events (AEs)
- REMs and regulatory creep
- cost and time of Phase IV regulatory demands

Major Constraints in Drug Discovery:

Comparative Effectiveness and Value Thresholds

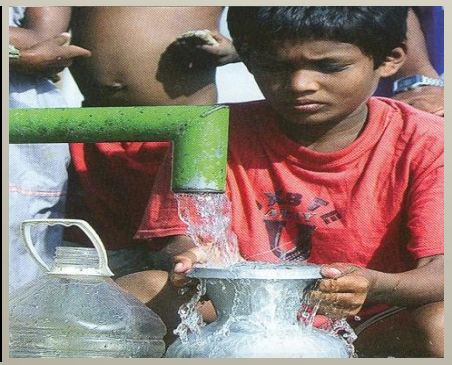
- the next hurdle?
- full range of therapeutic utility often not appreciated at initial approval
- highly variable combinations of ‘best practice’ Rx in different countries
- cost and risk of extended trials and erosion of patient life
- expanded ‘free loader’ opportunity for generics to enter markets earlier due to increasingly eroded patent life

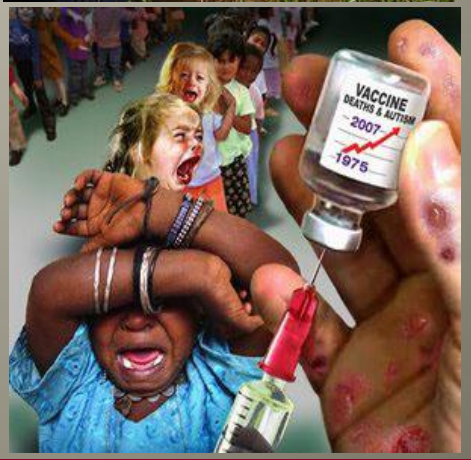
Drug Discovery:

Only for the Bold!

- sustained ‘high risk’ exercise
- uncertainty of ‘high reward’ absent increased predictability of clinical benefits
- no obvious immediate technological solutions to shorten protracted R&D cycle
- risk of shifting the current ‘valley of death’ to ‘valley of dearth’
- strategic imperative to define clear value propositions for new Rx

Global Health: Understanding the Implications of Major Economic and Environmental Dislocations





Redefining Healthcare Delivery

Harsh Realities
and
Stark Choices


The Strategic Future of Healthcare
Economic Unsustainability
or
Reform and Rational Care
Confronting the Imbalance Between Infinite Demand and Finite Resources

Market Distortions and Perverse Incentives in Modern Healthcare Delivery

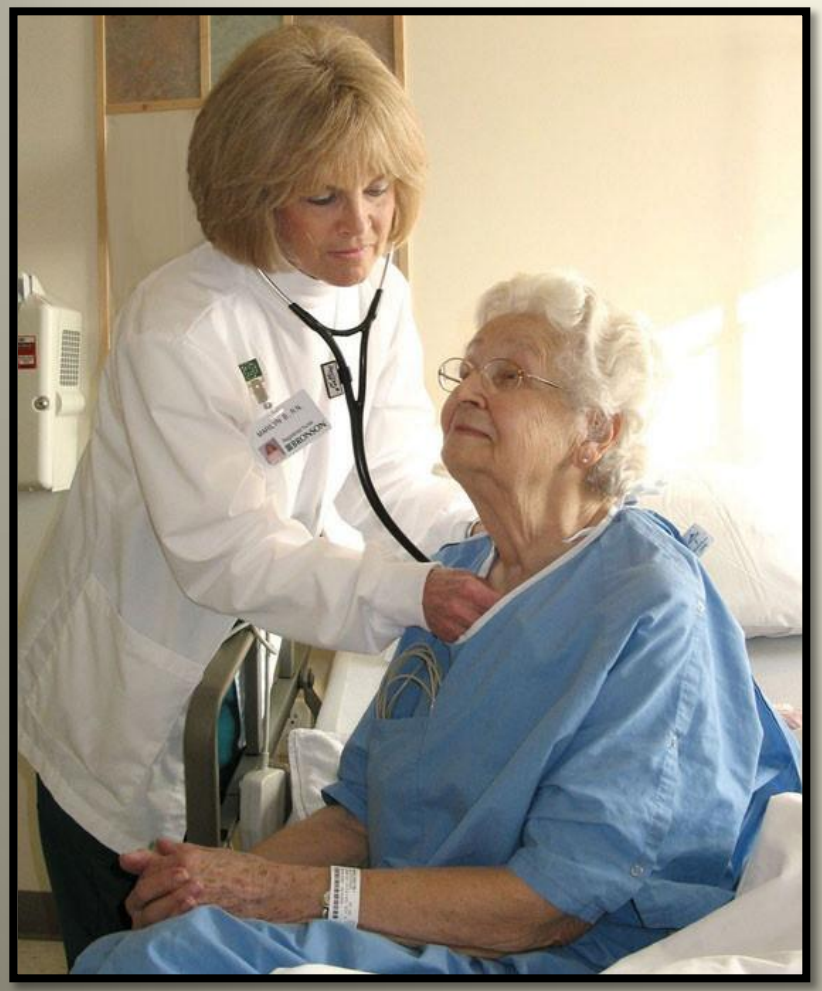
- focus on late-stage detection and intervention
  - high cost
  - low reversibility of chronic disease processes
- multiple reimbursements for fragmented (siloed) care versus integrated management of patient needs
- illness versus wellness
- inadequate social and economic incentives for wellness

U.S. Healthcare Costs are Unevenly Distributed

- 0.5% patients consume 25% of healthcare budget
- 1% consume 35%
- 5% consume 60%
- 10% consume 70%
- 75% of cost is for patients with chronic diseases

Source: Healthcare Reform Now
G. Halvorson,
Chairman and CEO
Kaiser Foundation Health Plan and Hospitals
Wiley, NY 2007 p.2

Demographics Trends and the Clinical and Economic Burden of Complex, Chronic Conditions/Co-Morbidities



- 23% Medicare beneficiaries have 5 or more conditions
- polypharmacy and AEs
- poor patient compliance
- multiple physician/venue encounters
- poor communication/ coordination between siloed healthcare services
- procedure-based reimbursement versus care continuum and outcomes

The Strategic Environment for the Pharmaceutical and Biotechnology Industries

- prospering in an environment of increasing constraints
- managing the limit(s) of society's willingness and ability to pay for innovation
- demonstrating the value of Rx
- harnessing the unprecedented opportunities for rational therapeutics and personalized care
- building the extended enterprise to optimize value-driven outcomes from rational Rx use
  - proficient integration of Dx, Rx, Ix and HIx

Defining New Value Propositions for Healthcare Delivery

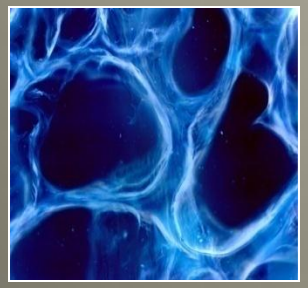
- social and economic value of reducing disease burden will rise
  - earlier disease detection and mitigation
  - rational Rx and guaranteed outcomes
  - integrated care management of complex chronic diseases
  - extension of working life

New Vistas in Biotechnology with Potential for Major Therapeutic Advances

- selective modulation of gene expression via siRNA

- regenerative medicine: programming cellular differentiation and autologous cell therapy

- synthetic biology: cells as novel Rx/vaccine delivery systems or diagnostic sentinels

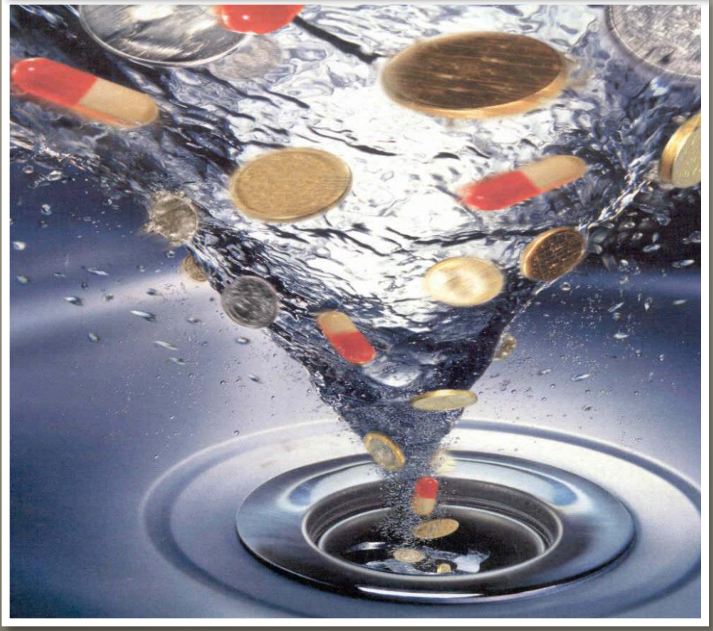


- tissue engineering: novel biomatrices for repair and remodeling

Molecular Diagnostics and Miniaturized Devices: Increasing Importance in the Future Healthcare Value Chain

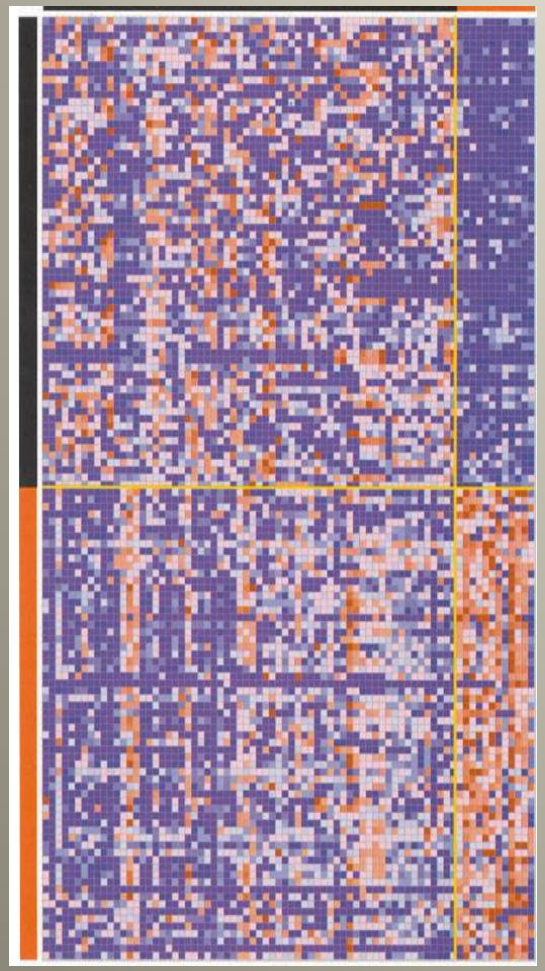
Ignoring The Obvious in Clinical Practice

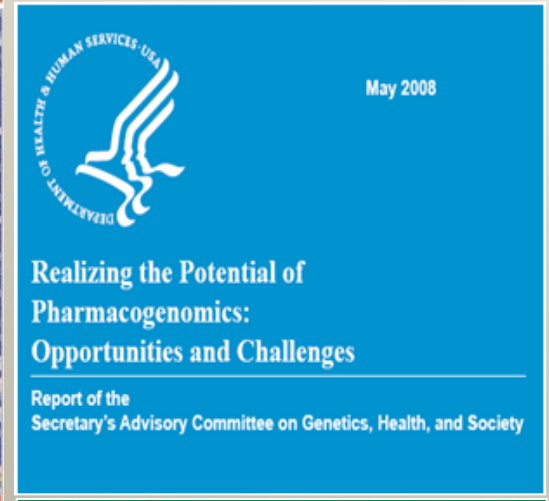
- diseases are not uniform
- patients are not uniform
- a “one-size fits all” Rx approach cannot continue

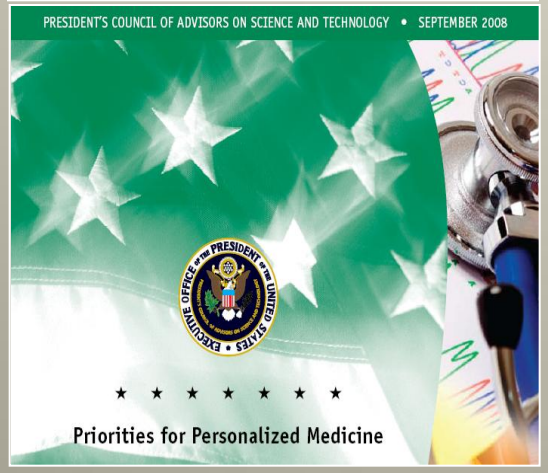


- inefficiency and waste of empirical Rx
- cost of futile therapy
- medical error and AEs

Rational Therapeutics and Personalized medicine: Key Drivers

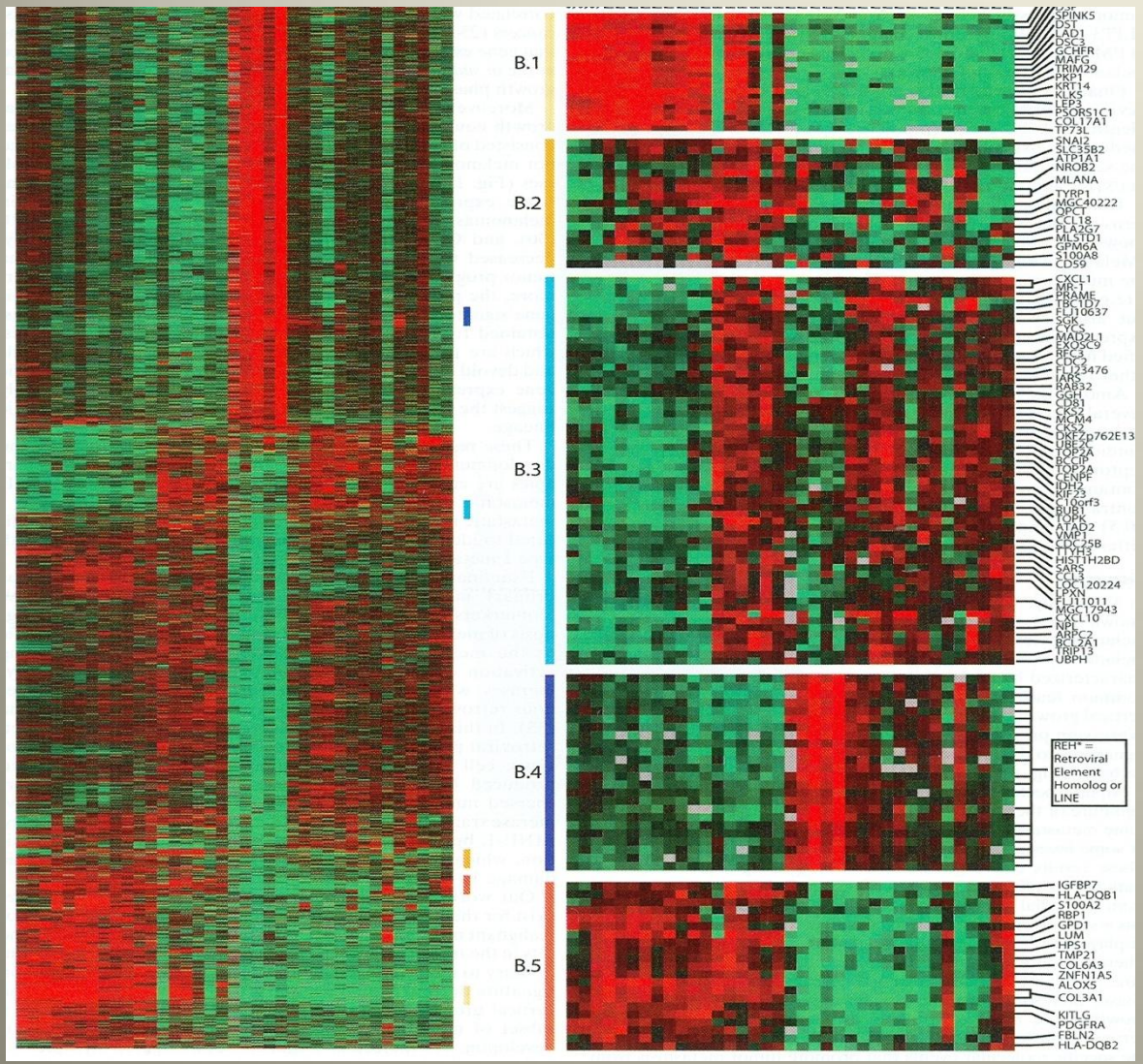






Science **Policy** **Cost and Outcomes**

Disease Subtyping: Next-Generation Molecular Diagnostics (MDx) and A New Molecular Taxonomy of Disease



Dx Platforms

- massive parallelism
- miniaturization
- automation
- rapid
- POC

RIGHT Rx for RIGHT DISEASE SUBTYPE

B1 skin, B2, melanocytes, B3, melanoma, B4 and 5 metastatic melanoma
From: C. Haqq et al. (2005) 102, 6092

Molecular Diagnostics and Disease Subtyping

"Riches in the Niches"

- right diagnosis, the first time
- right Rx selection, the first time
- rise of Dx-Rx combination
- Rx approval and labeling
- reimbursement only with obligate Dx?

The Emergence of Drug: Diagnostic Combinations

SELZENTRY™ (maraviroc) tablets

Pfizer

trofile™ CO-RECEPTOR TROPISM ASSAY

biosciences monogram

The Mark of Individualized Medicine

CAMPTO® irinotecan

Pfizer

Invader® chemistry

THIRD WAVE TECHNOLOGIES

COUMADIN® (Warfarin Sodium Tablets, USP) Crystalline

1mg 2mg 2.5mg 3mg 4mg 5mg 6mg 7.5mg 10mg

Bristol-Myers Squibb

Verigene® System

Nanosphere

5-Fluorouracil

Xeloda® tablets capecitabine

Roche

TheraGuide 5-FU™

A test to predict toxicity to 5-FU/capecitabine-based chemotherapy

MYRIAD®

Vectibix™ (panitumumab)

AMGEN

DxS Diagnostic Innovations

K-RAS Profiling and Anti-EGFR Monoclonal Antibody Therapy

- greater response in patients with K-RAS versus mutant-
- estimated $604 million/year savings (ASCO)

regulatory demand

clinical guidelines

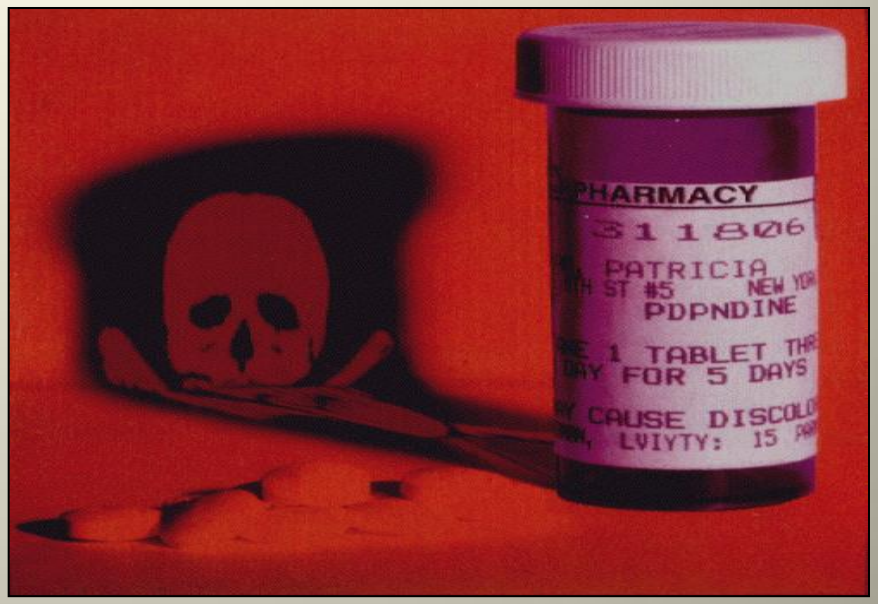
- regulatory inertia

- payor adoption

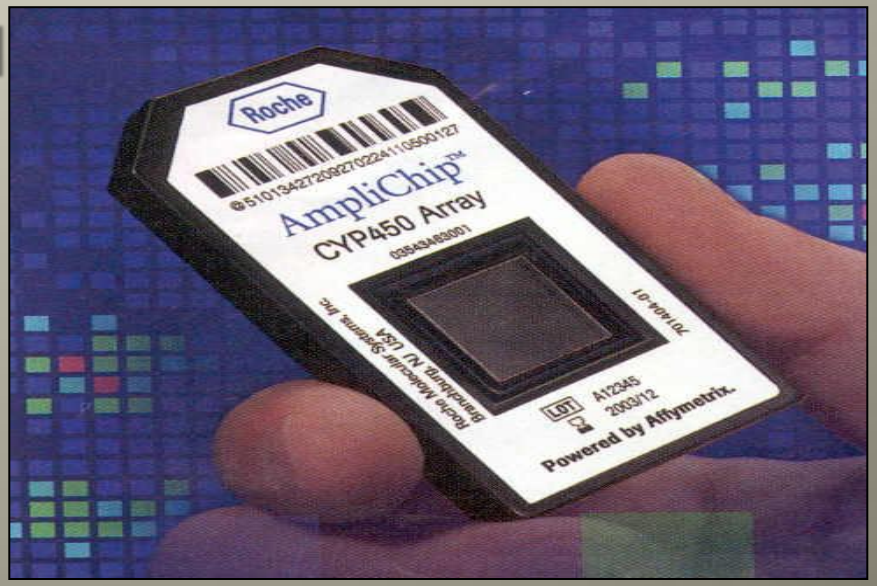
Molecular Diagnostics and Targeted Therapeutics

- premium pricing for predictable Rx outcomes
- pay-for-performance (P4P)

Pharmacogenetic Predisposition to Adverse Drug Reactions



- 1.5 to 3 million annual hospitalizations (US)
- 80 to 140 thousand annual deaths (US)
- est. cost of $30-50 billion



REMS:
Risk Evaluation and Mitigation Strategies

Product	Manufacturer
Plenaxis (abarelix)* for prostate cancer	Praecis
Lotronex (alosetron) for irritable bowel syndrome	Prometheus
Letairis (ambrisentan) for pulmonary arterial hypertension	Gilead
Tracleer (bosentan) for pulmonary arterial hypertension	Actelion
Clozaril (clozapine), ***Fazaclo ODT*** (clozapine) for schizophrenia	Novartis, Azur and generics
Tikosyn (dofetilide) for atrial fibrillation/atrial flutter	Pfizer
Soliris (exulizumab) for paroxysmal nocturnal hemoglobinuria	Alexion
Ionsys (fentanyl hydrochloride)*, ***Actiq*** (fentanyl citrate) for pain	Alza, Cephalon
Accutane (isotretinoin) for acne	Roche and generics
Revlimid (lenalidomide) for myelodyslplastic syndromes and multiple myeloma	Celgene
Mifeprex (mifepristone) for pregnancy termination	Danco
Tysabri (natalizumab) for multiple sclerosis and Crohn's disease	Biogen Idec/Elan
ACAM2000 (smallpox vaccine, live)	Acambis
Xyrem (sodium oxybate) for daytime sleepiness and cataplexy	Jazz
Thalomid (thalidomide) for multiple myeloma and leprosy	Celgene

** Plenaxis and Ionsys are currently not marketed in U.S.*

Pink Sheet (2008) 31 March, p. 7

Alert
7/24/08

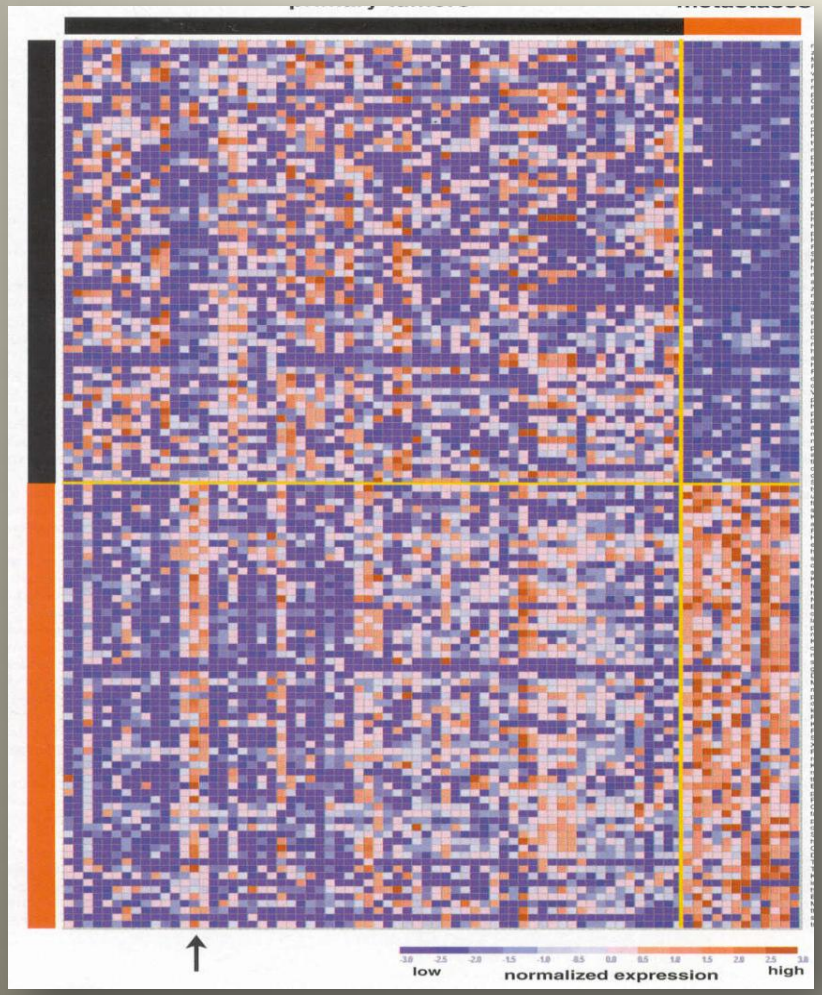
- update labeling for Abacavir (Ziagen) to require pre-therapy screening for HLA-B*5701 allele to avoid fatal hypersensitivity

Table of Valid Genomic Biomarkers in the Context of Approved Drug Labels

http://www.fda.gov/cder/genomics/genomic_biomarkers_table.htm

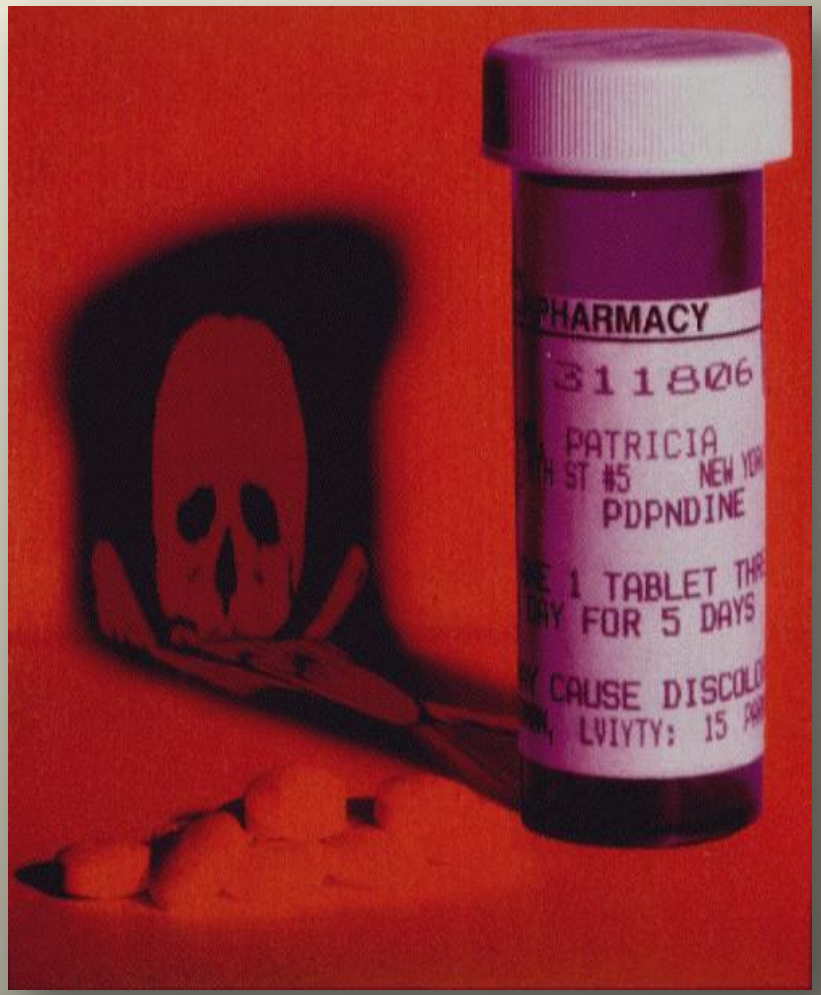
From Pharmaceuticals to Pharmasuitables

Disease Subtyping:



Right Rx for Right Disease

Individual Variation and AE risk



Right Rx for Right Patient

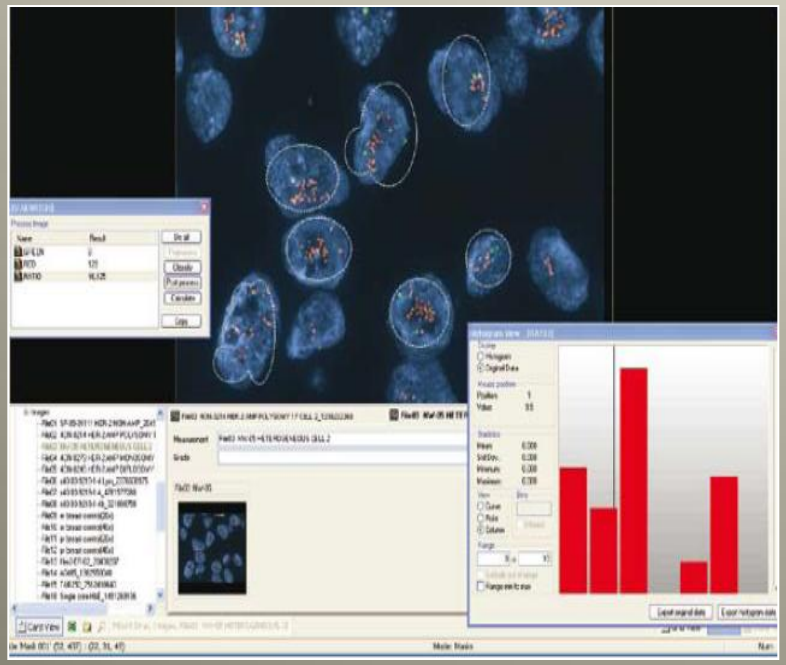
Personalized Medicine
The Initial Era: Targeted Rx

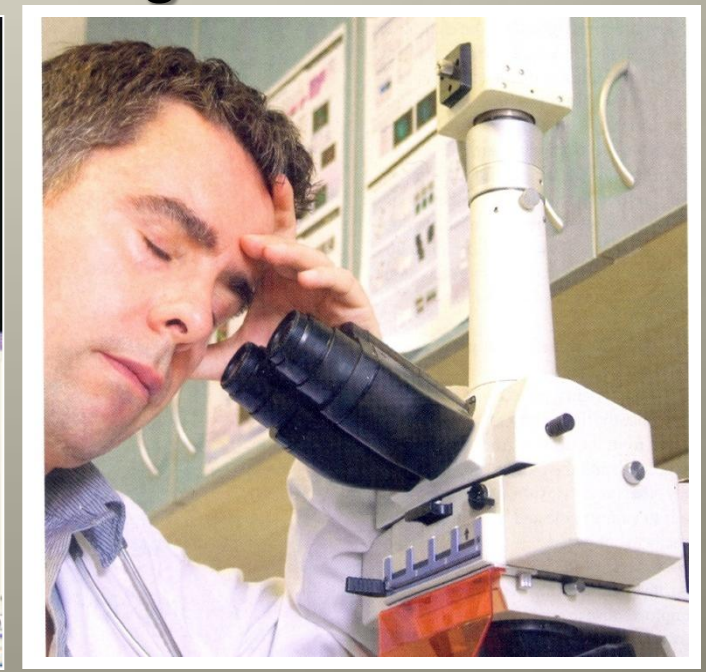
- opening era in linking disease molecular pathology to rational Rx
- increasing payor, regulatory and public pressures for reliable ID of Rx-responsive patients
- demand for Dx-Rx combinations will intensify
- Dx-Rx combination will become an obligate element of NDA/BLA submission and product labeling
- development of Dx-Rx combinations as intrinsic components of R&D programs for investigational Rx

New Technology Platforms for Molecular Diagnostics

Automated Image Analysis and Digital Pathology "Virtual Pathology"

- automated high throughput capabilities
- greater efficiency of machine-based image analysis
  - no observer fatigue
  - reduced inter-observer variability
- quantitative analysis
- crucial importance of standardization
- global sourcing for 24/7 coverage





Trends in Mapping Diagnostic Signatures of Health and Disease

unianalyte	multiplex
simple analytical endpoint(s)	complex analytical algorithms
technician dependent	high throughput automation lab-on-a-chip remote fault-diagnostics/repair
centralized laboratory	migration to POC wireless remote monitoring
population-based reference index	individualized profile and longitudinal person record as reference index

Deriving Value from "-Omics"
The Challenge of Biomarker Validation

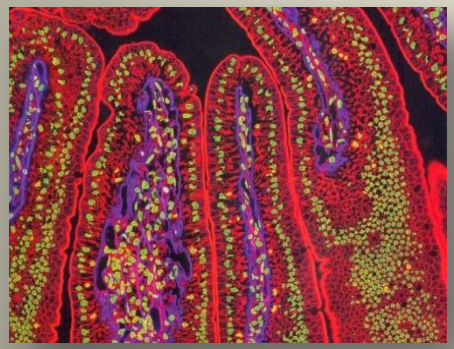
Genomic, Proteomic and Metabolomic Data

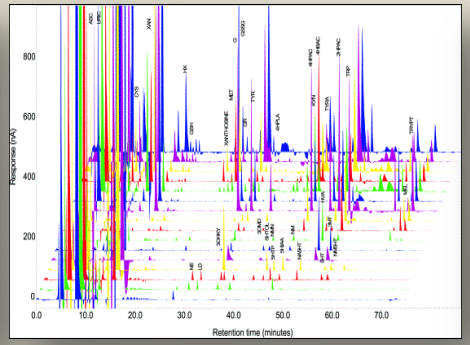
- useful only when correlated with additional parameters
  - clinical outcomes
  - clinical utility
  - actionable information
  - demonstrable economic value

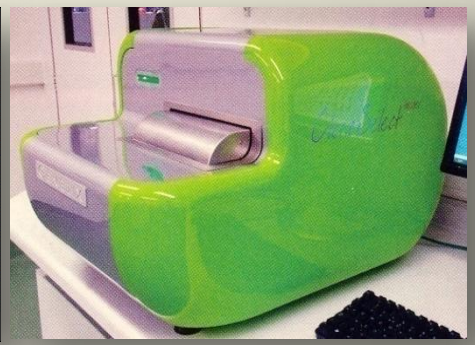
Biomarkers And Novel Molecular Diagnostics (MDx)

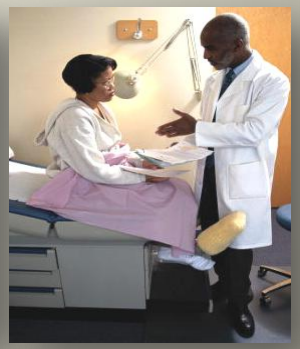
- literature dominated by anecdotal studies
  - academic laboratories
  - small patient cohorts
  - limited replication and confirmatory studies
- lack of standardization
- very few biomarkers subjected to rigorous validation
  - case-control studies with sufficient statistical power
  - inadequate stringency in clinical phenotyping
- widespread lack of understanding of regulatory requirements
  - complexities imposed by multiplex tests
  - new regulatory oversight

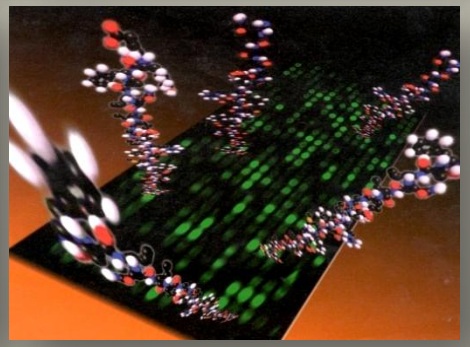
Identification and Validation of Disease-Associated Biomarkers: Obligate Need for a Systems-Based Approaches

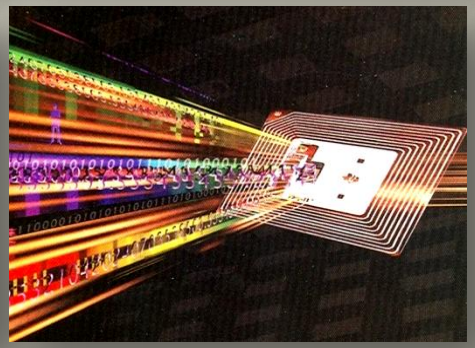












Biospecimens and Molecular Pathway Analysis

Biomarker Validation and Multiplex Assays

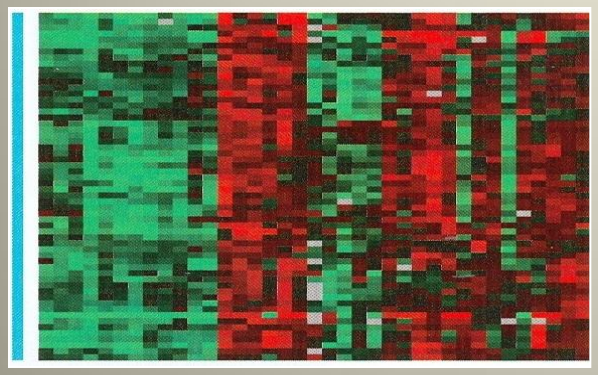
Instrumentation and Informatics

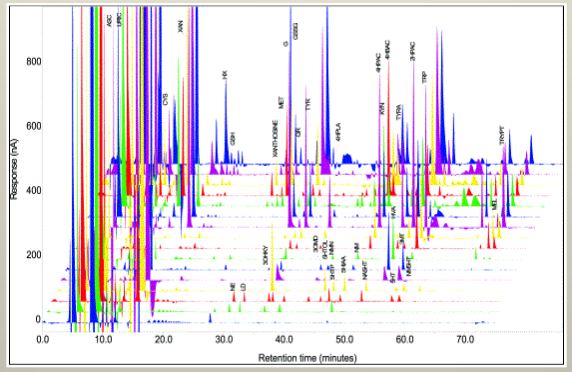
Clinical Impact and Patient Monitoring

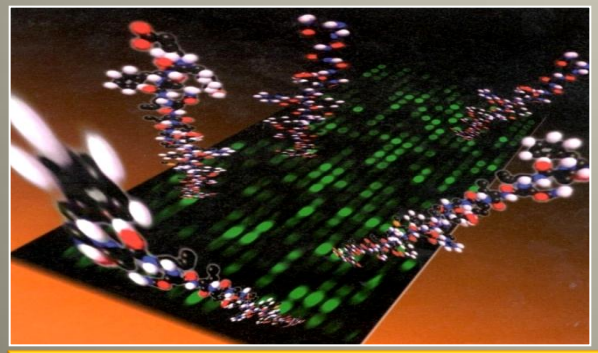
Development of Molecular Diagnostics and Biomarkers for Personalized Medicine: The Need for End-to-End R&D Solutions

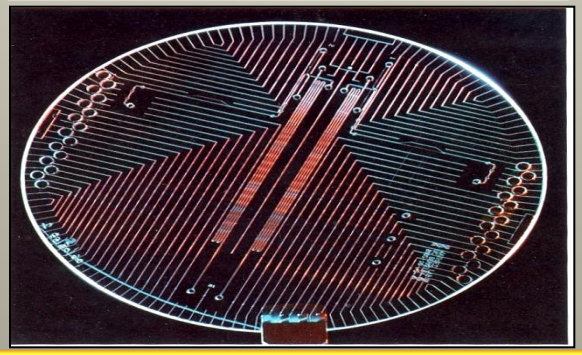
Complex Biosignature Profiling

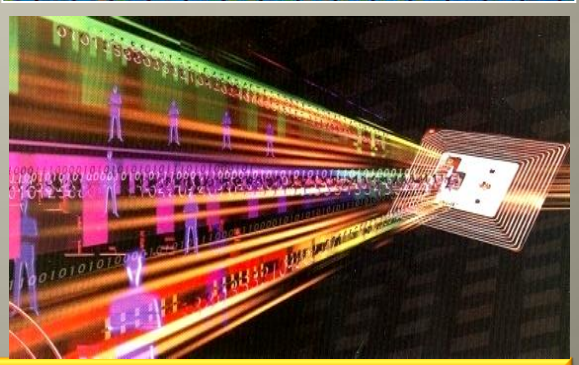
genomics	proteomics	immunosignatures











Signature Detection, Deconvolution and Multivariate Analysis

multiplex assays	novel test devices (POC)	new algorithms

Next-Generation Molecular Diagnostics and New Patterns of Regulatory Oversight

In Vitro Diagnostic Multiplex Index Assay (IVDMIAs)

- patient-specific result (score or index)
- analytical/interpretational algorithm non-transparent to end user
- result cannot be independently derived or confirmed by another laboratory without access to proprietary information used in the development and derivation of the test

Genentech Citizen Petition to the FDA on Laboratory-Developed Tests (LDTs)

Genentech
IN BUSINESS FOR LIFE

"request FDA regulatory jurisdiction over all LDTs" December 2008

ACLA
American Clinical Laboratory Association

"Genentech's proposal poses a chilling effect on innovation in patient care while stifling the promise of personalized medicine."

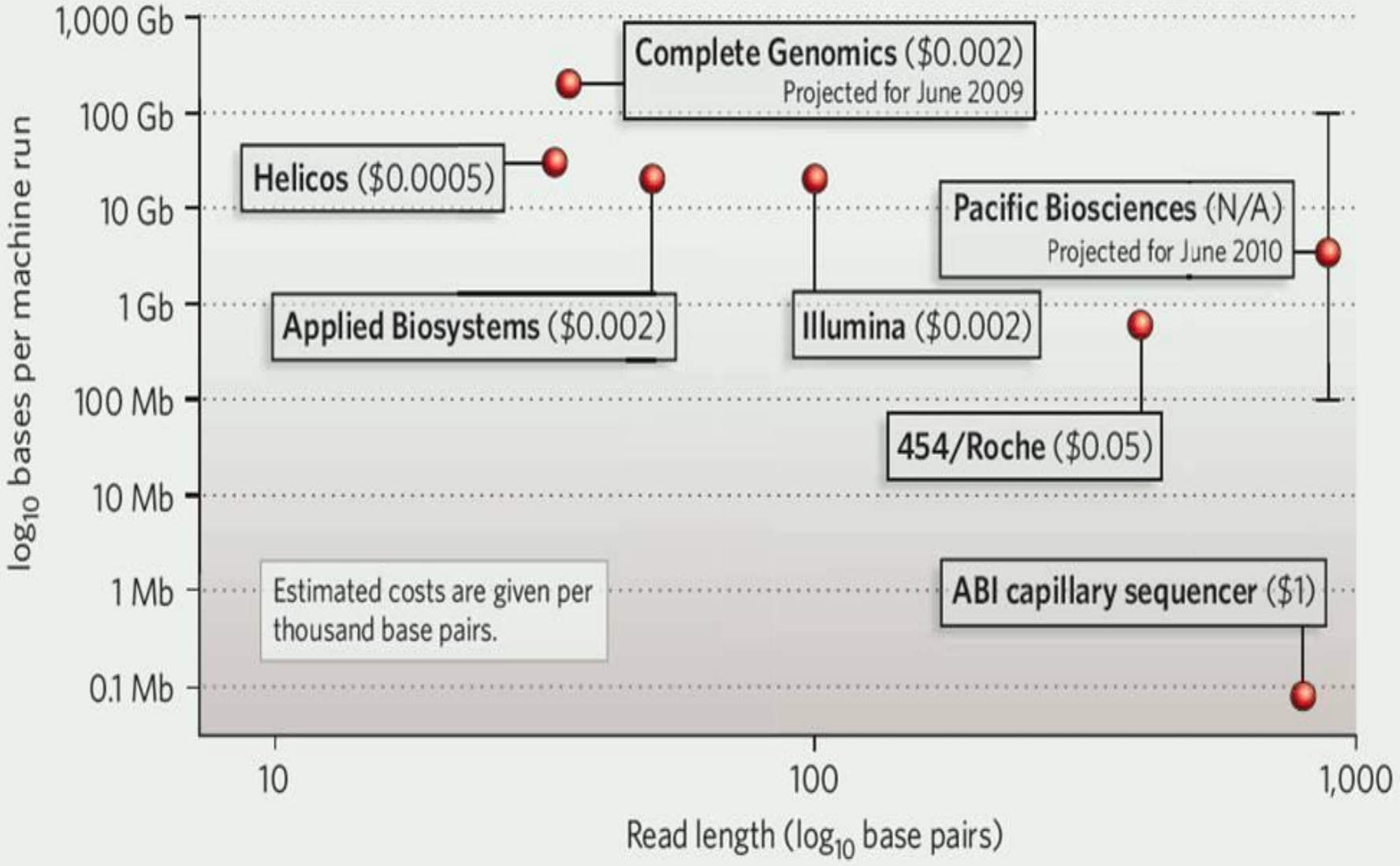
January 2009

“These new regulations will fundamentally change the way we get around them”.

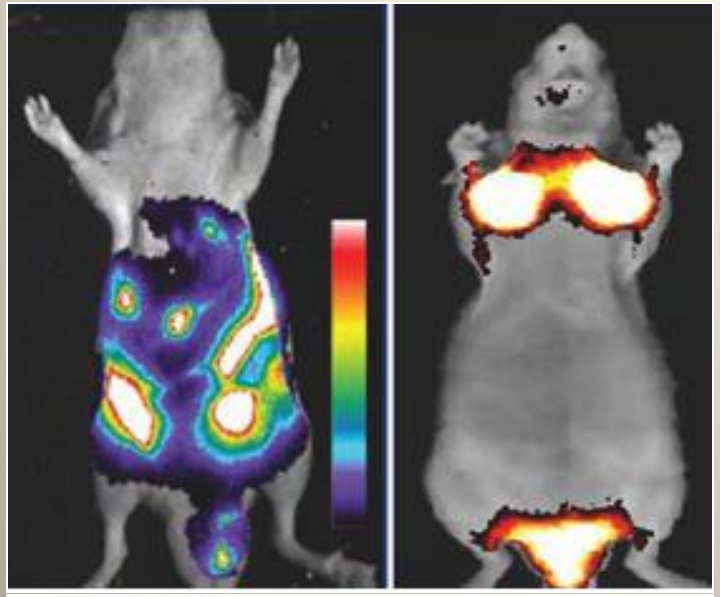
Will Lost Cost Sequencing Change Everything?

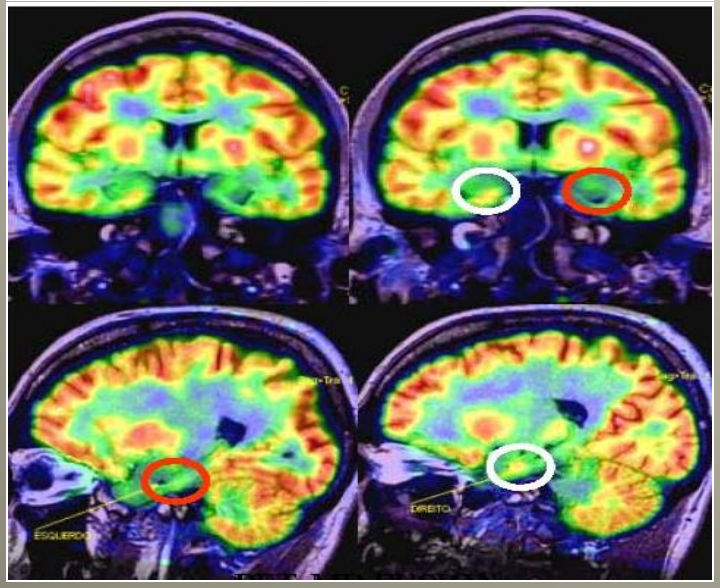
THE SEQUENCING RACE (Nature 2009, 457, 768)

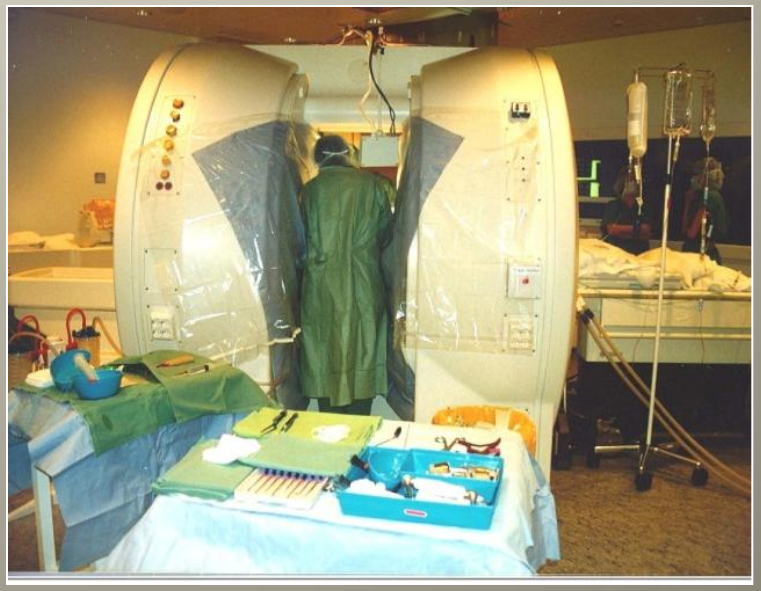
The increasingly crowded market for genome-sequencing machines includes new entrants looking to push the boundaries in both speed and accuracy.



In Vivo Imaging





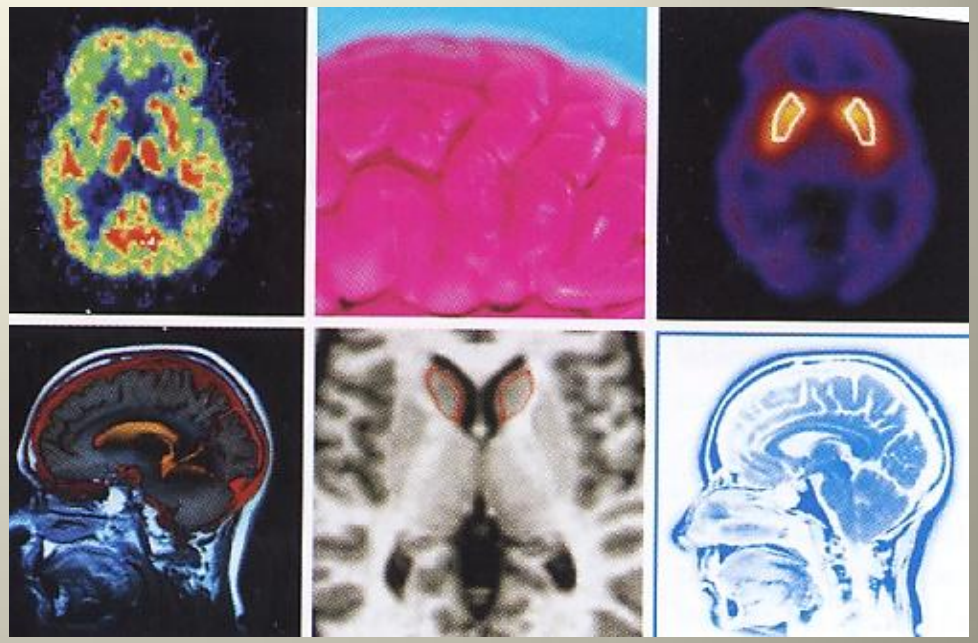


Nanoscale Systems and Targeting Materials to Specific Body Locations

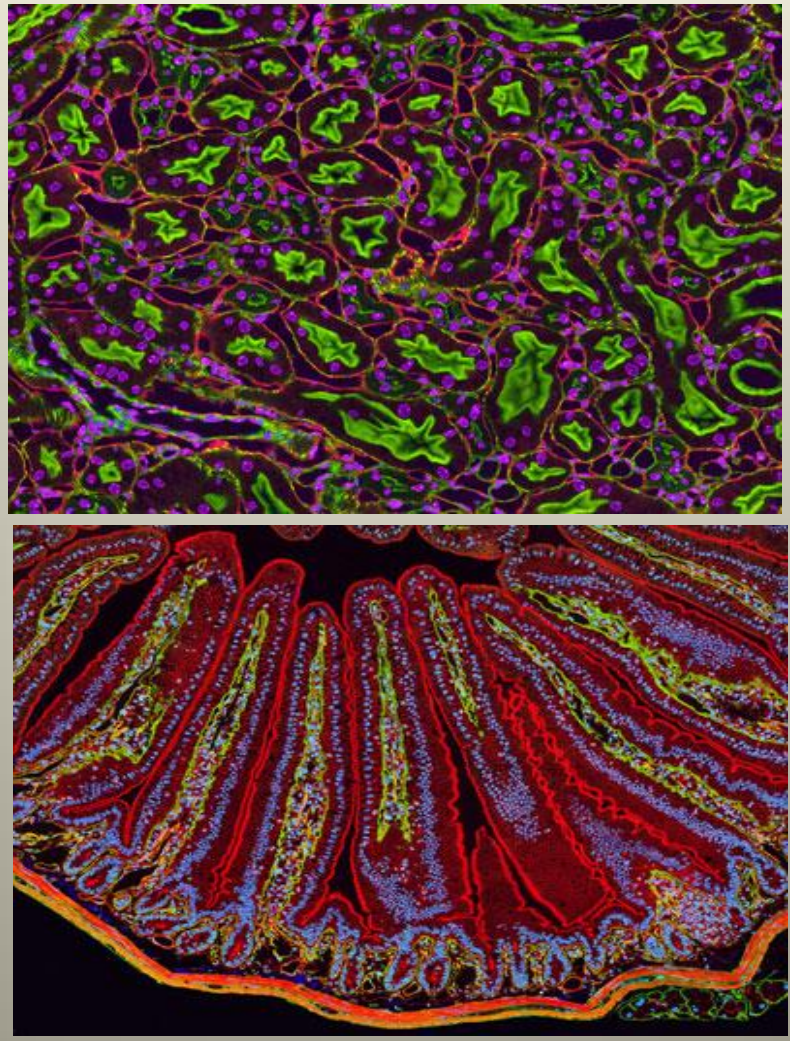
Application

- next-generation body imaging for resolution of specific cell types/metabolic activities (versus current whole organ profiling)

- advanced drug and gene delivery systems for target specific localization and release



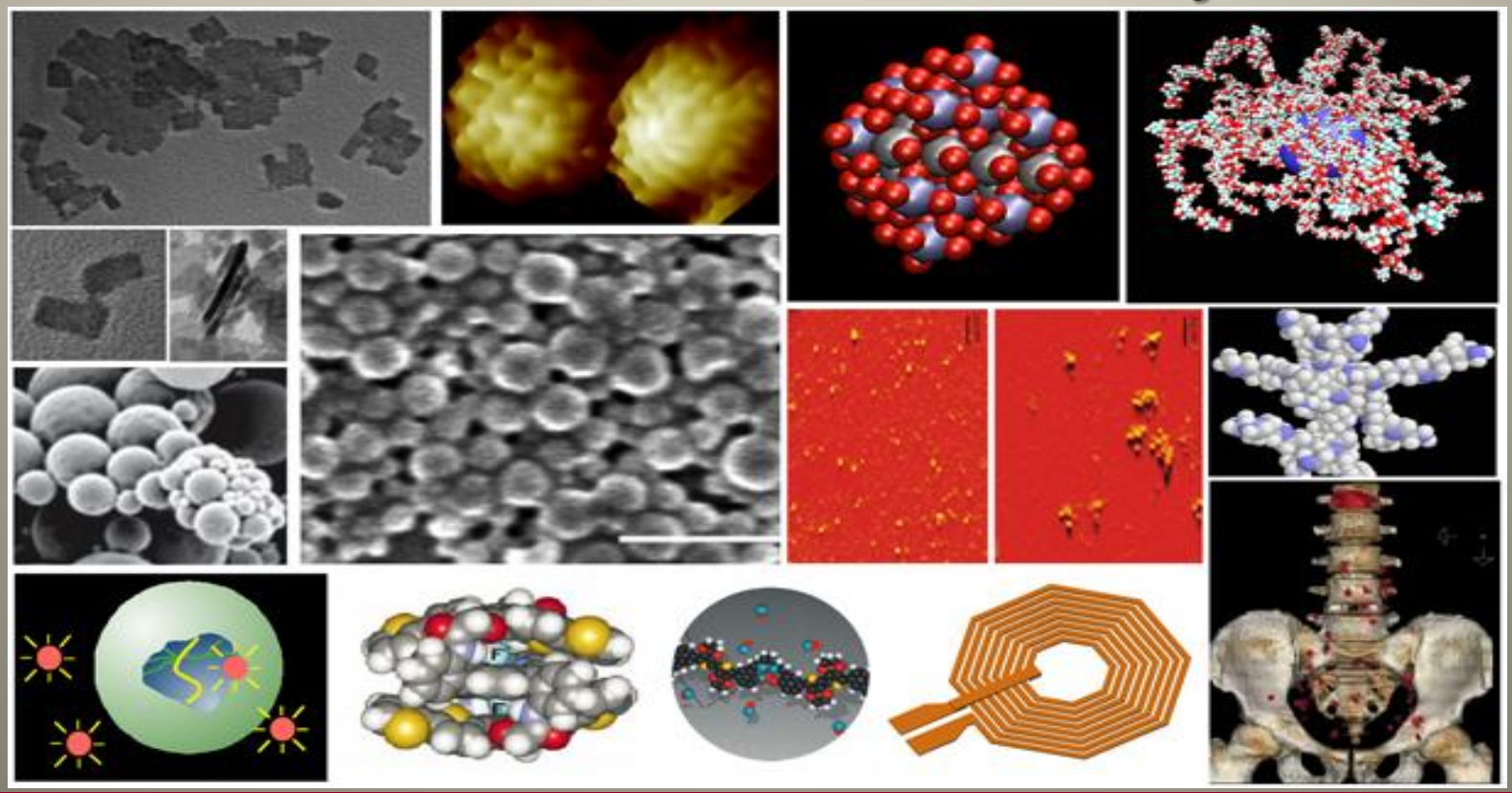
Q-Dots and Next-Generation Imaging Probes



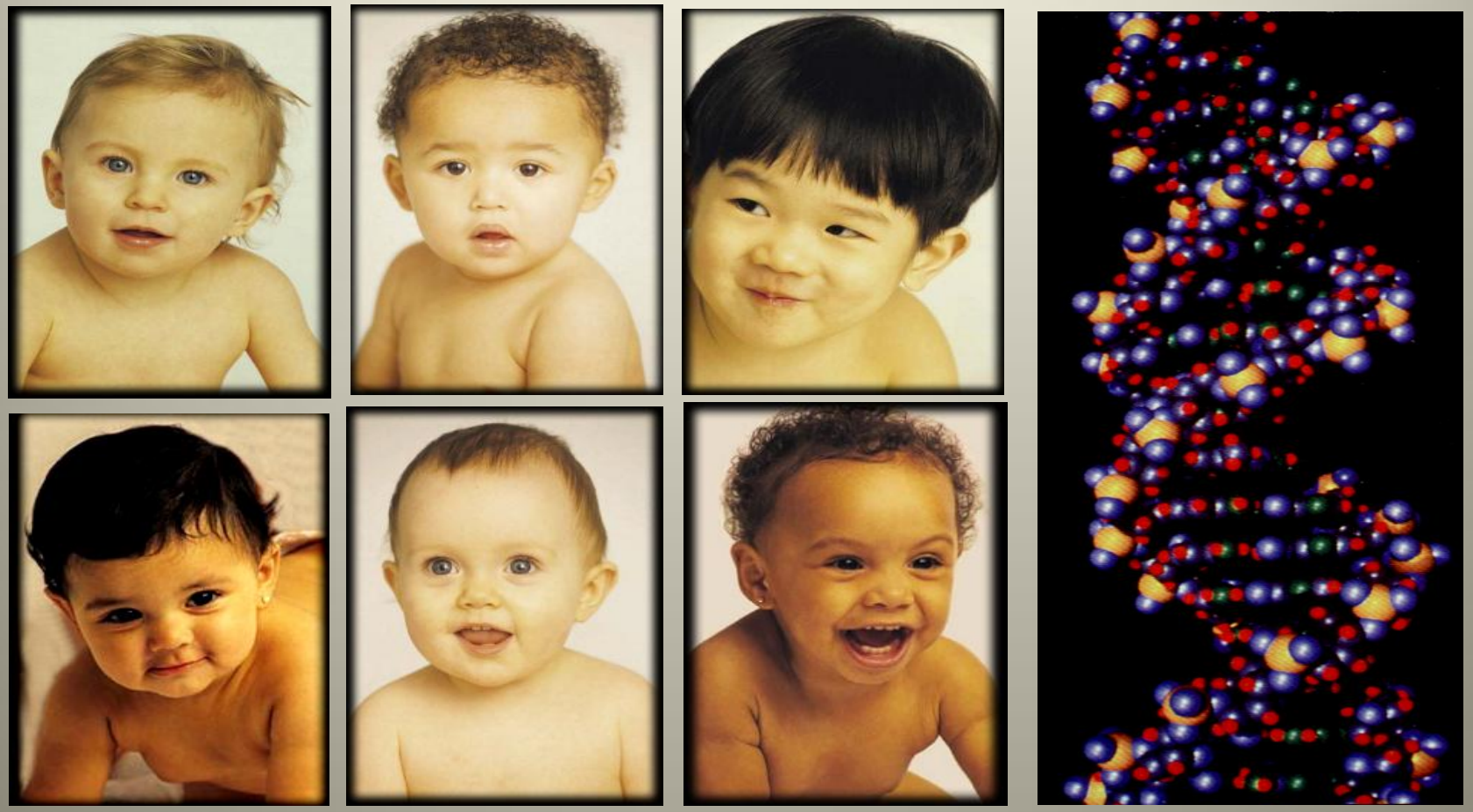
Use of near-IR probes for deep tissue analysis and real-time scanning

Interactions of Nanoparticles with Living Systems

- complexity of particle composition, geometry and routes of distribution
- complexity of biological processes involved in recognition, transport and disposal
- societal needs for information on safety



Personalized Medicine: Disease Predisposition Profiling



Disease Predisposition Risk Profiling for Common, Multigenic Late-Onset Disorders

- slower evolution than many predict
- Genome-Wide Association Studies (GWAS)
  - high cost, complexity and poor replication
  - multiple low penetrance alleles
- substantial ambiguities regarding probabilistic risk of overt diseases
  - epistasis
  - epigenetics
  - environmental confounders
  - source of poor replication of GWAS studies?

The premature quest to provide consumer genomic testing (CGx) for future risk of major diseases


DNAdirect
Your Genes In Context


Consumer Genetics
Bringing Science Home


CyGene
LABORATORIES


GeneLink


GENECARE
Medical Genetics Center


GENETIC
TECHNOLOGIES, INC.
DNA / FORENSIC / PATERNITY TESTING


genelex


g-Nostics


Graceful Earth
Graceful Earth
Health Alternatives:Customized Dietary,Nutritional and Herbal Information


HealthCheckUSA


INTERLEUKIN
GENETICS
Empowering


MediChecks.com


23andMe


NEUROMARK


SURACELL
Personal Genetic Health™


The International
TLC-Wellbeing Clinic
Wellbeing through Science, Nutrition and TLC.
Est. 1987. Treating Clients in over 100 Countries.


Navigenics


Knome


ScientificMatch.com
"The Science of Love"

Consumer Genomics: Predisposition Risk Profiling for Late Onset, Multigenic Diseases

- validity of claimed gene-disease associations
- communication of probabilistic risk
- health literacy and consumer response to ‘risk’ information
- effectiveness in motivating health improvements
- role of MD and/or genetic counselors in request/interpretation of test in varied care settings
- psychological impact on future behavior and knowledge of familial implications

Personal (Consumer) Genomics

- choice and personal empowerment

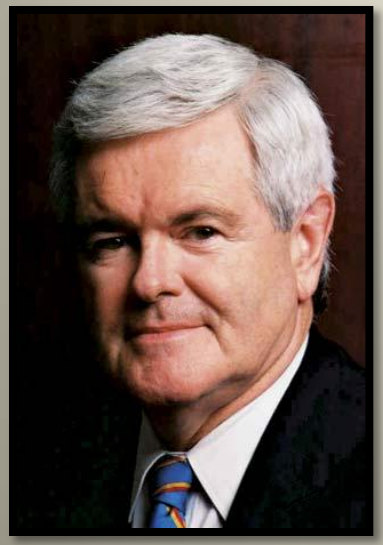
versus

- medical profession and state protectionism
- evidentiary standards and regulation

Molecular Profiling and Biomarkers for Improved Diagnosis and Rational Therapeutics

If you build it will they pay?

Misaligned Reimbursement Incentives: Rewarding Process Versus Results



"You have a (healthcare) system that traps us into bad performance because it's the only way you can bill"

Hon. Newt Gingrich
Medical Device Daily (2009) 27 Jan. p8

"If it isn't billable – it isn't going to happen!"

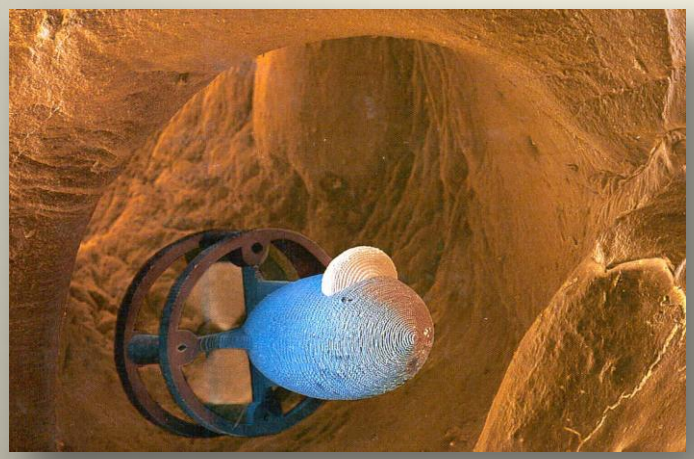
Reimbursement for Diagnostic Tests

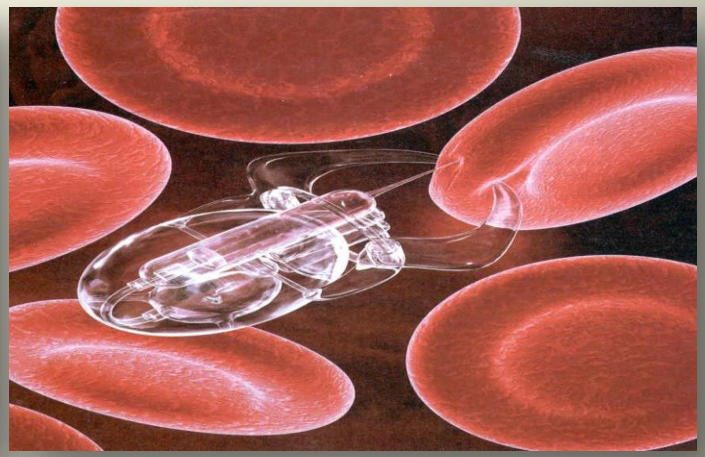
The Imperative for Value-Based Pricing versus Current Cost-Based Models

- **inadequate US Medicare coding and payment mechanisms**
  - **out moded, out-dated, lacking in transparency, inconsistently applied**
- **inappropriate assignment of existing CPT codes to new tests**
- **engagement of third party payers who derive economic/clinical value from new Dx**

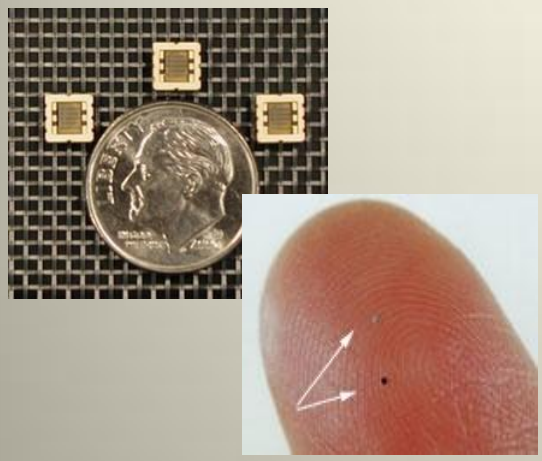
Health Status Monitoring and the Promotion of Wellness

On Body: In Body Sensors/Devices
For Real Time and Remote Monitoring of Individual Health Status



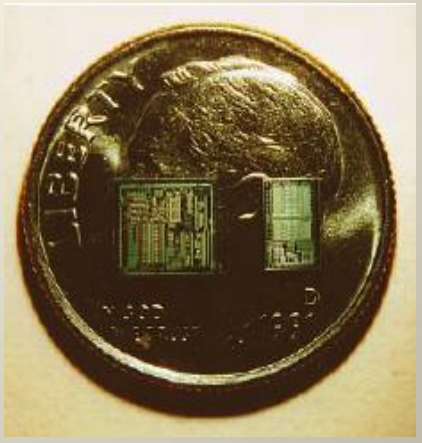


OBIBS and Body Area Networks (BAN's) for Remote Monitoring of Health



Microtags

In-Body Wireless Tags



Sensor on a Chip

"Savings from broad-band remote monitoring
for all chronically ill patients
are potentially quite remarkable
….as much as 30 percent
of all hospital, out-patient and drug expenses"

Robert Litan
Kaufman Foundation December 2005

cited in: Advancing Healthcare Through Broadband
Internet Innovation Alliance White Paper 2007

On Body: In Body Sensors and Devices

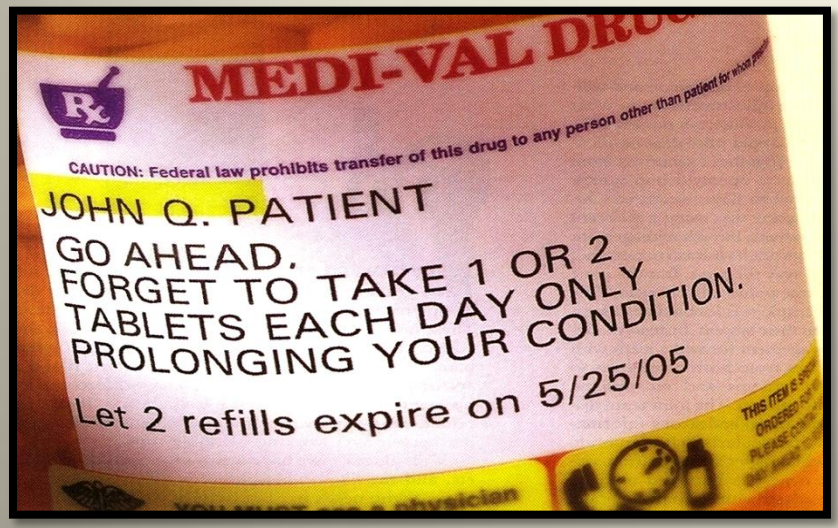
Objective

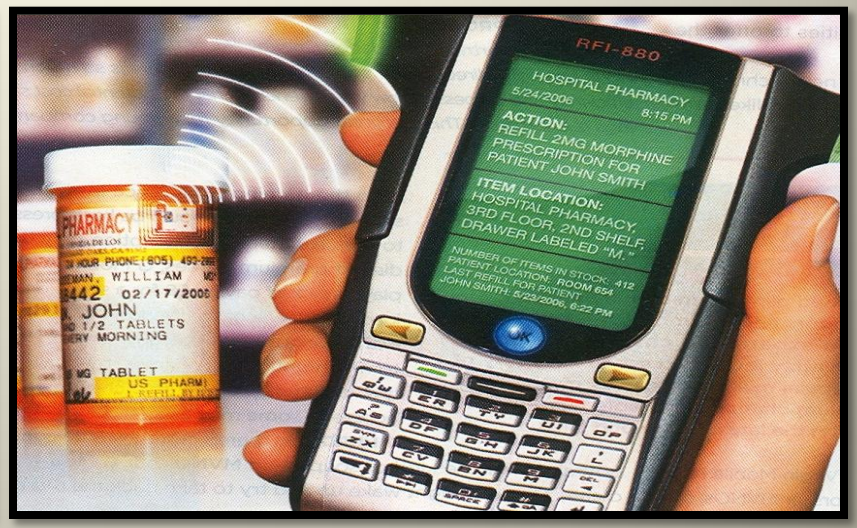
- remote monitoring of health status

Applications

- multi-feature monitoring and broad-band wireless networks
  - ubiquitous sensing
- enhanced autonomy for in-home aged
- proactive alerting and intervention to mitigate health incidents
- monitoring of patient compliance
- coupled linkage to remote Rx dispensing for efficient disease management

The Costs of Non-Compliance with Rx Regimens



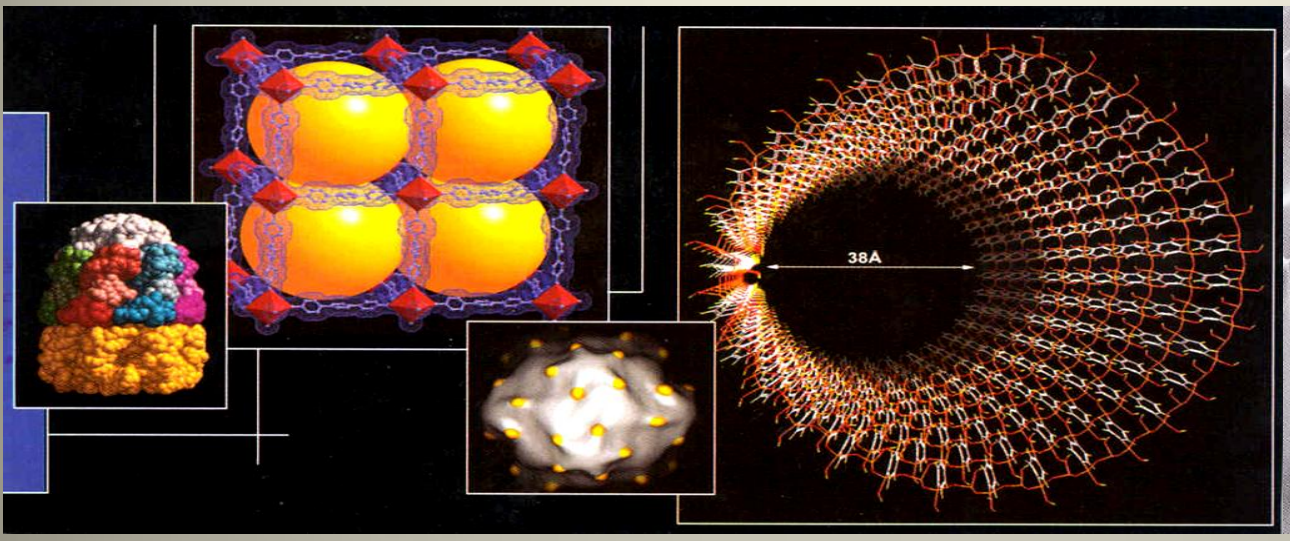


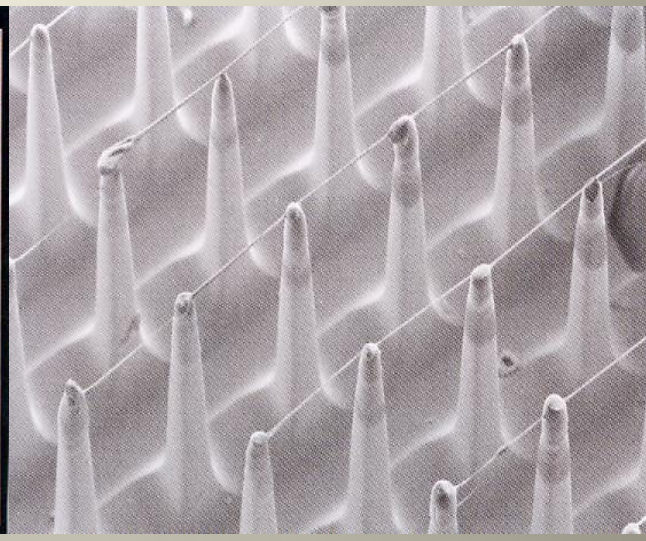
- **$177 billion projected cost**
- **20 million workdays/year lost (IHPM)**
- **40% of nursing home admissions**
- **projected 45-75% non-compliance (WHO)**
- **50-60% depressed patients (IHPM)**
- **50% chronic care Rx (WHO)**

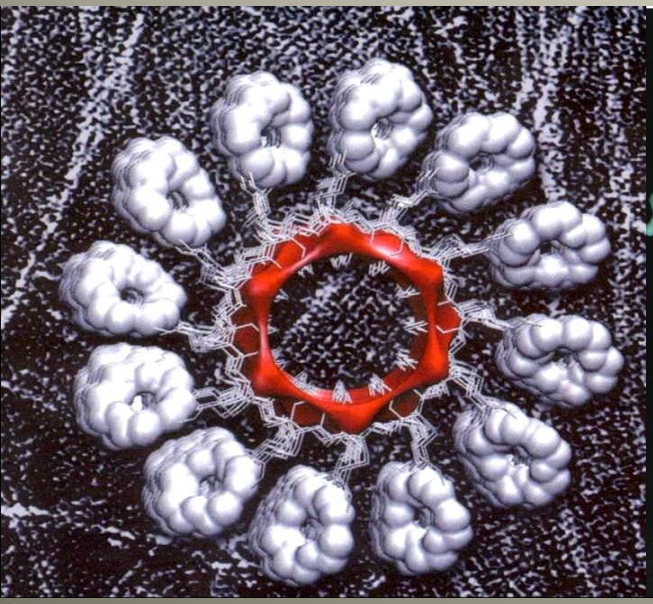
Ubiquitous Sensing: (Ambient Intelligence) Instant Information: Anything, Anywhere, Anytime

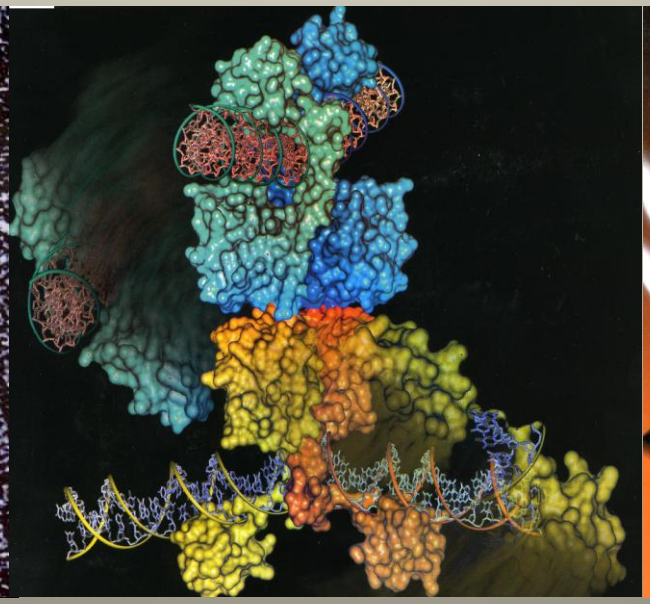
- miniaturized sensors and a monitored world
  - healthcare, agriculture, ecosystems, infrastructure, security
- from deep blue to deep space to inner space
- “intelligent” adaptive sensor networks
- global connectivity and network information architecture(s)
- rich data streams for monitoring population-based activities and social networks
- complex legal, ethical and social implications

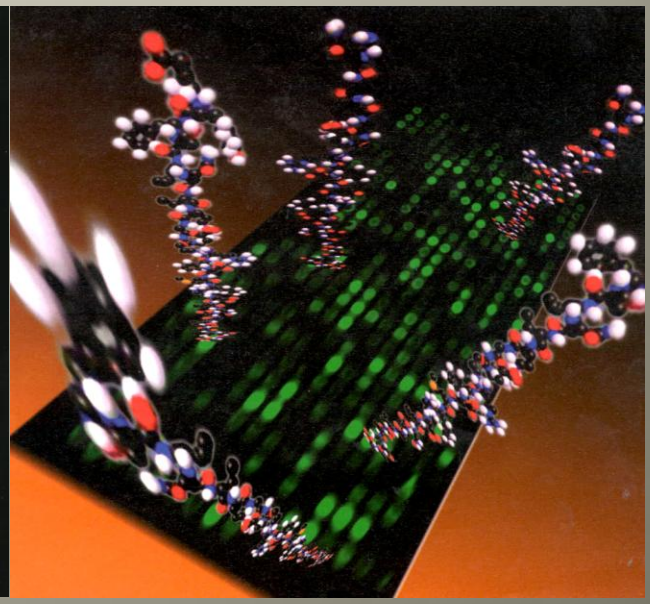
Novel Materials, Nanoscale Molecular Assembly and Bio-inspired Diagnostics and Sensors







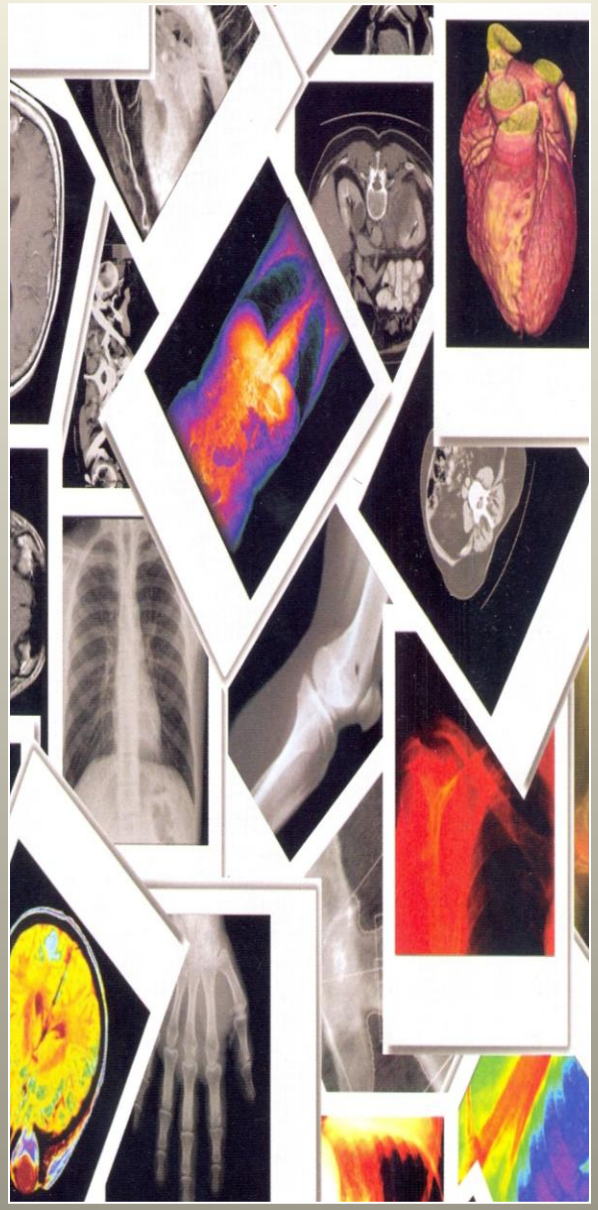




Directed Molecular Assembly (DMA) and Design of Novel Diagnostics, Sensors and Devices

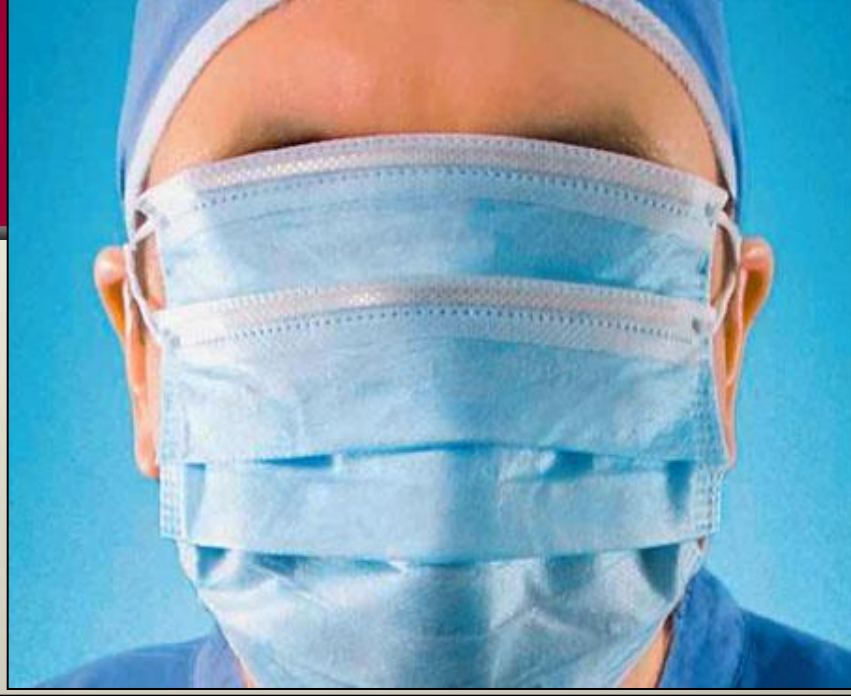
- micro- and nano-fabrication technologies
- organic: inorganic and biotic: abiotic coupling
- ‘intelligent’ and self-assembling systems
- biosensing and biofunctional materials
- shape-memory materials
- ‘Lab-on-a-Chip’ (LOC) and Point-of-Care (POC) diagnostic platforms
- ‘smart’ (targeted) drug delivery and cytomimetic materials
- novel power systems for on-body: in-body sensor and device systems (OBIBs)

How Much New Technology Can We Afford?



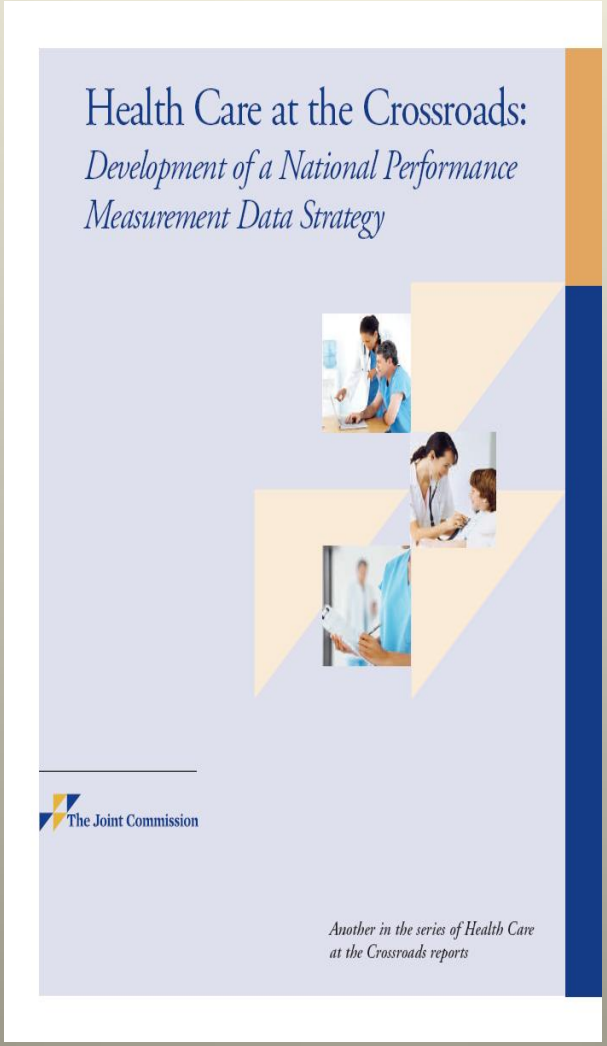
Knowing What Works (or Doesn't)

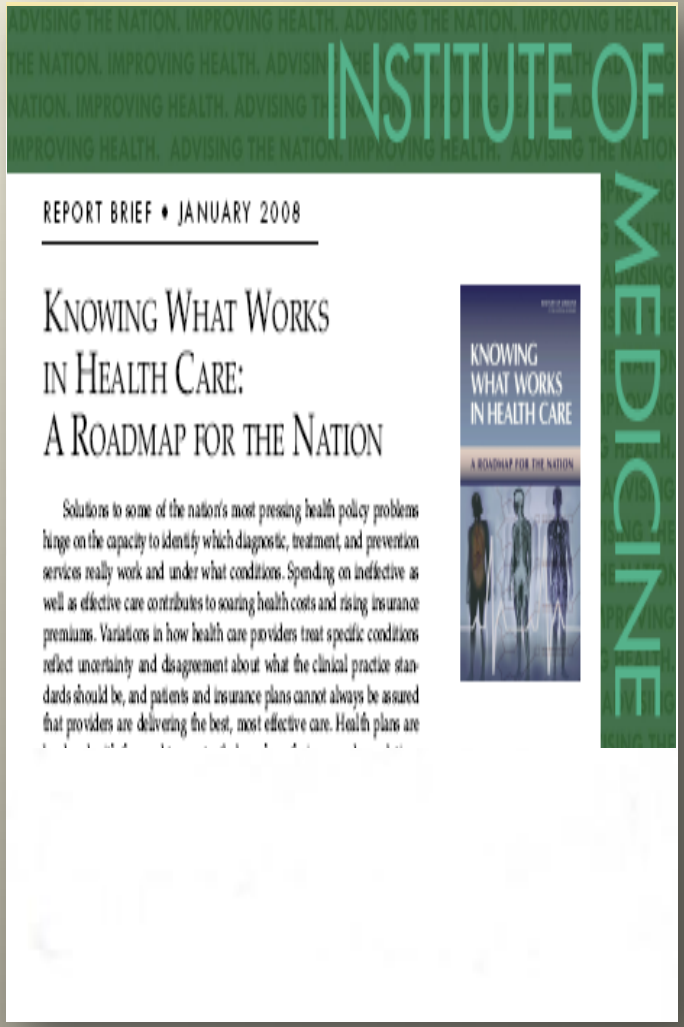
- Pervasive Inefficiencies and Errors in Healthcare Created by Empirical Care and Lack of Robust Outcomes and Performance Data



The High Price of the Lack of Evidence

- **$2.3 trillion healthcare economy**
- **$110 billion R&D investment**
- **$0.9 billion on technology assessment**
- **additional $1.2 billion in 2009 “stimulus” package**



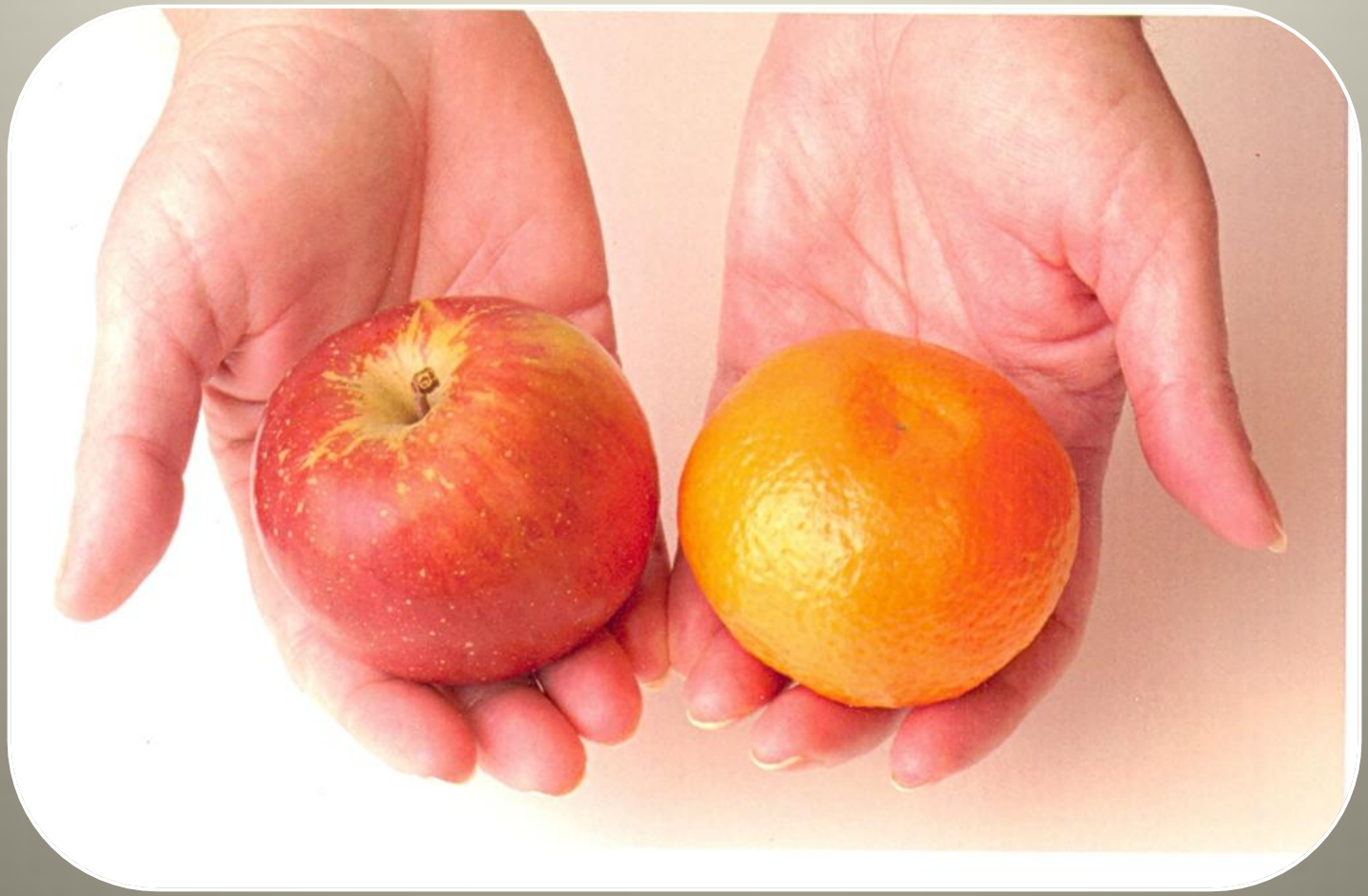


Measurement of Performance and Quality in Healthcare Delivery

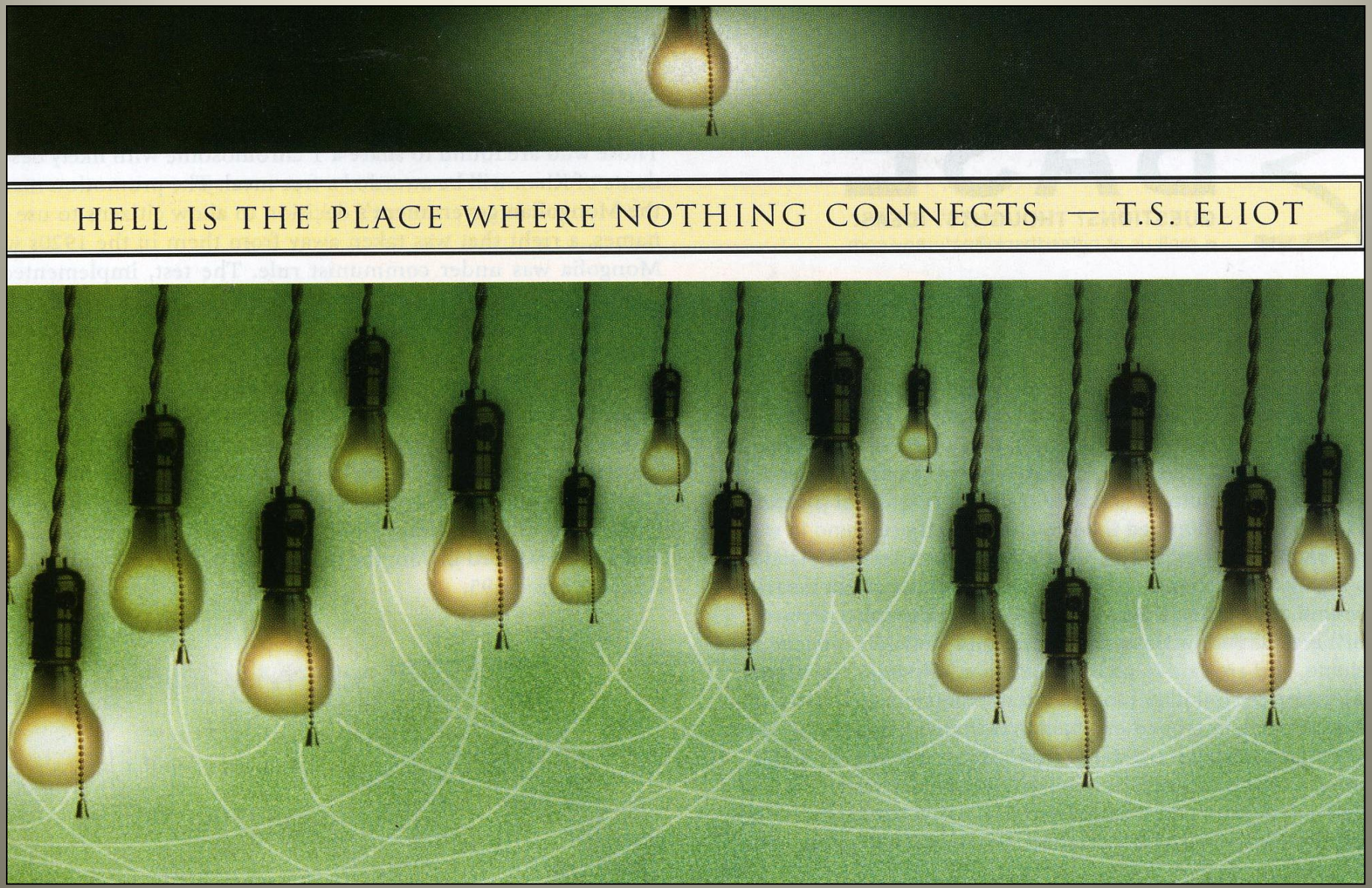
- continued investment in low-priority/high cost care over high-benefit care exacerbates current market distortions
- new incentives
  - superior clinical and economic outcomes via coordinated care in chronic disease
  - shift focus from reimbursement of uncoordinated procedures/interventions to rewards for disease mitigation and wellness

“Not everything that counts can be counted,
and not everything that can be counted, counts”

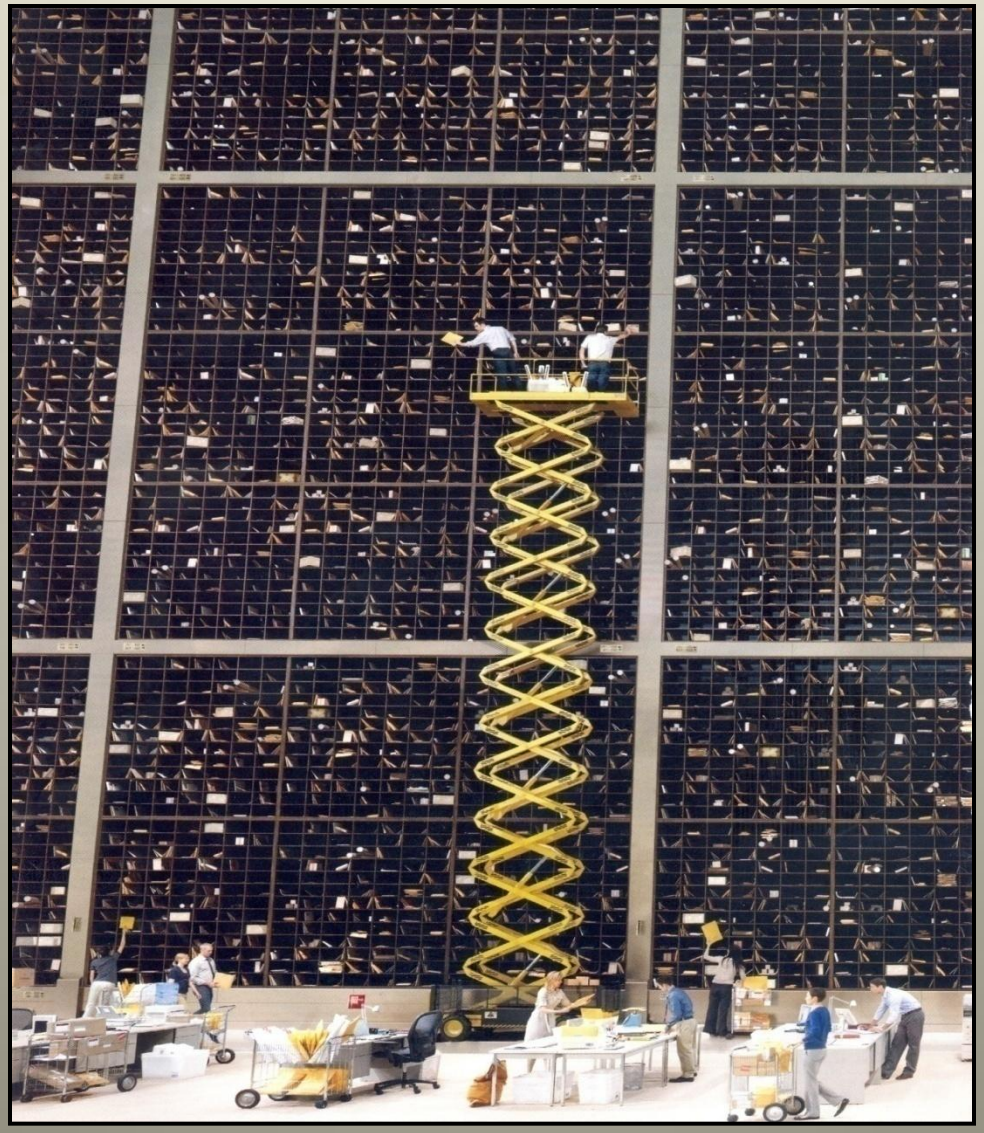
Albert Einstein



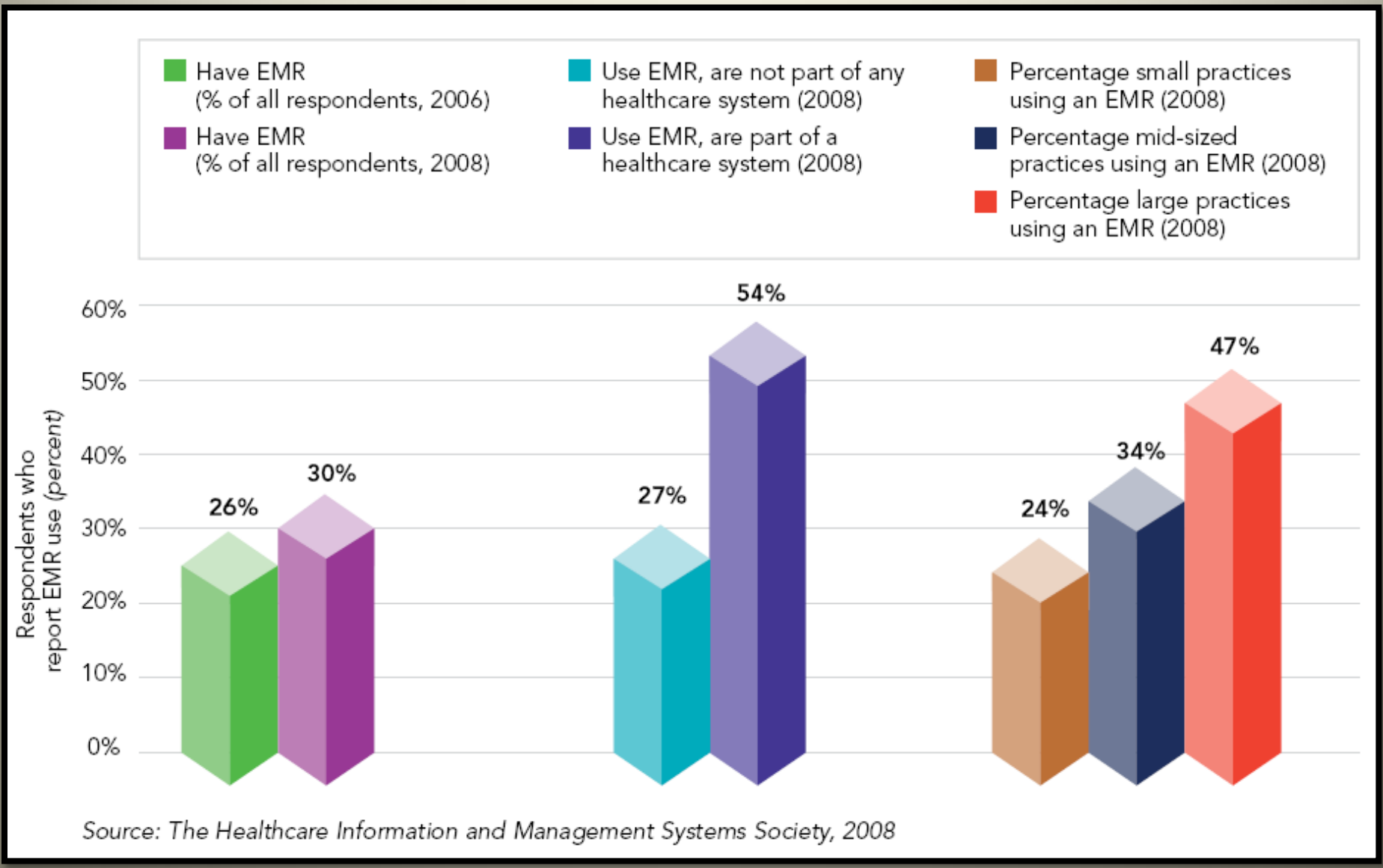
Information-Based Medicine



Paper Kills!: The Inefficiencies and Risks Created by Sustained Dependence on Paper Healthcare Records



Electronic Medical Records Use by Healthcare Providers



American Recovery and Reinvestment Act (ARRA) 2009

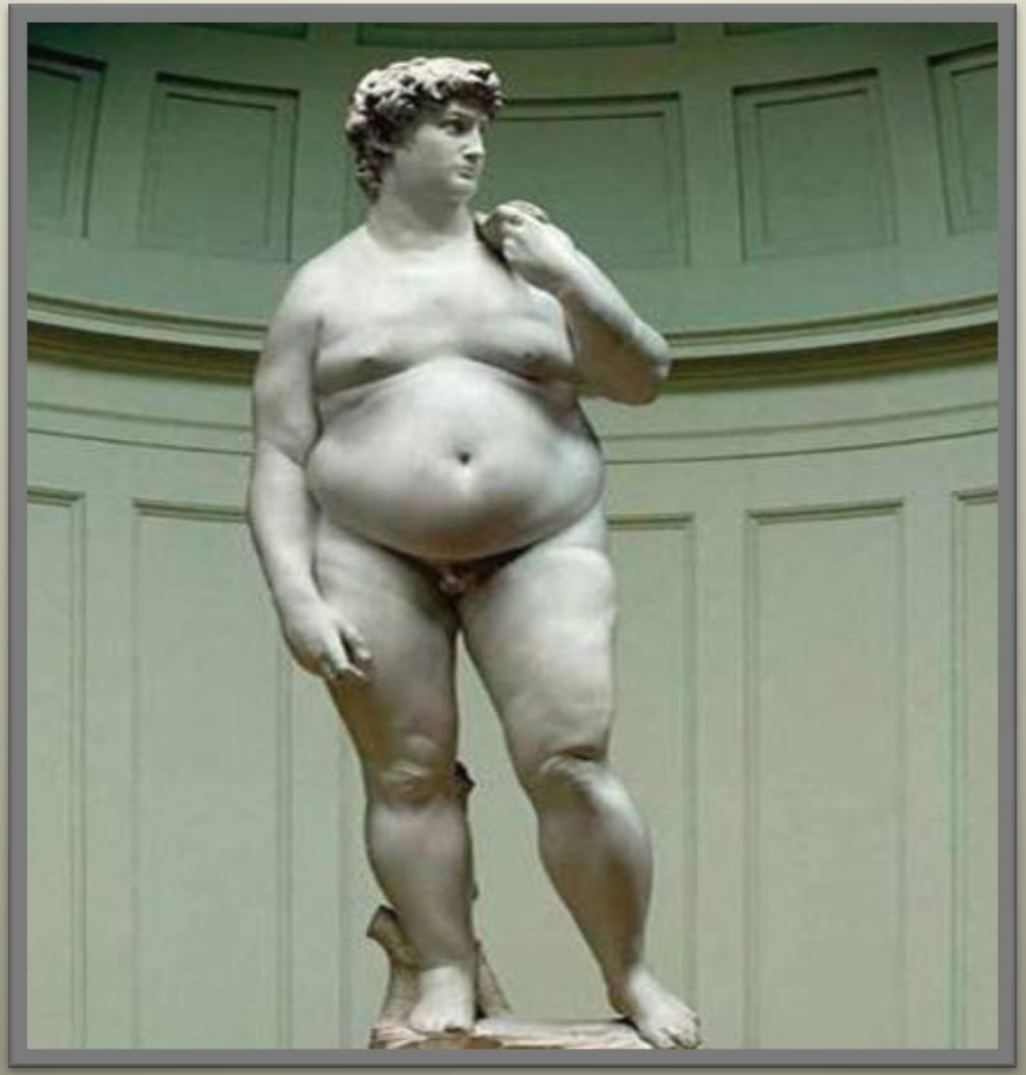
- $19 billion for healthcare IT
- Medicare payment up to $44K for physician with qualifying EHRs (2011)
- Medicare reductions for physicians/hospitals that lack qualifying HER by 2014
- CPOE by 2011 to qualify for Medicare incentive payments
- HITECH: separate new law embedded in ARRA
  - Health Information Technology for Economic and Clinical Health Act
  - policies/standards for national HIx network

Consumer Directed Healthcare Plans

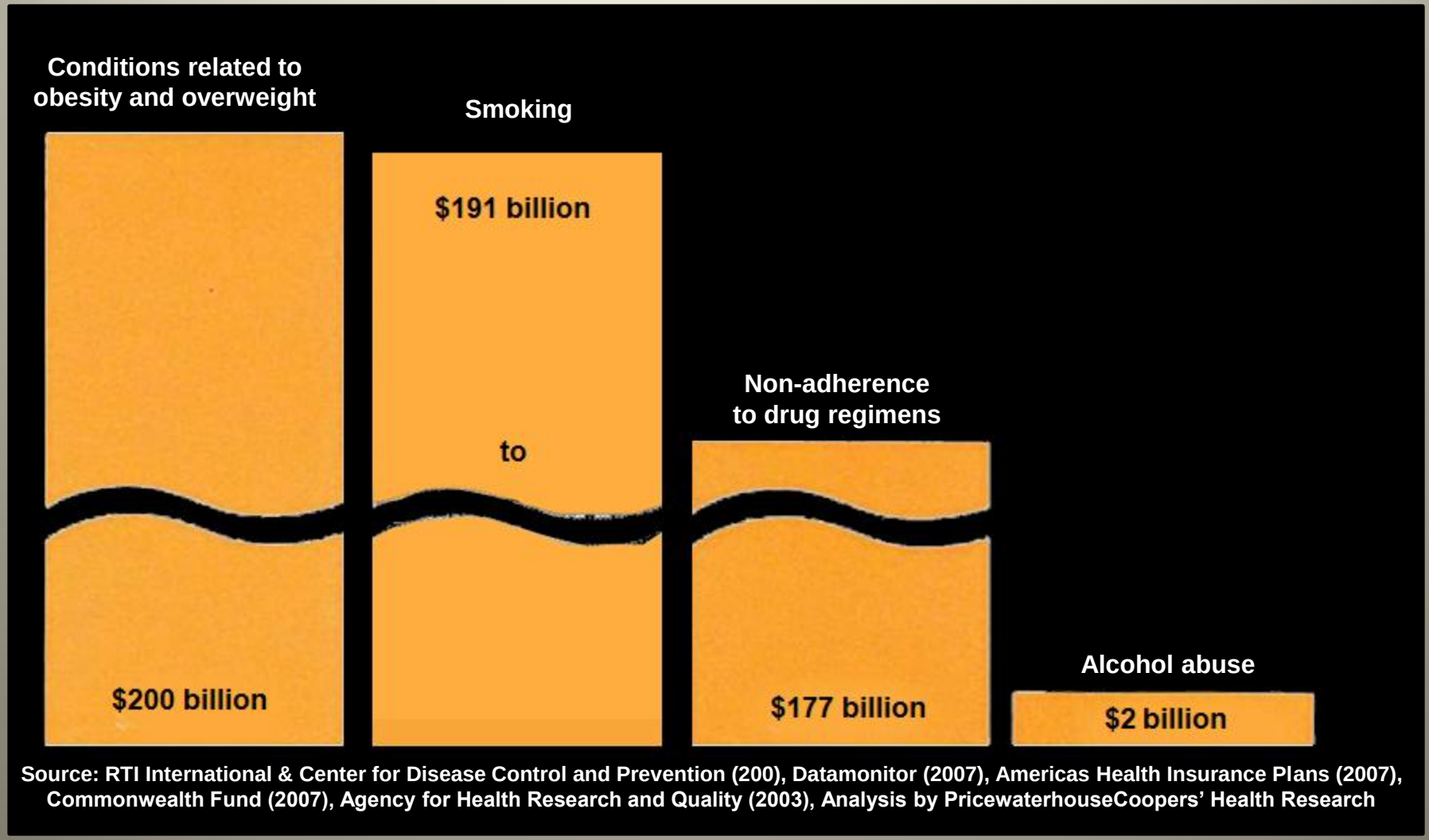
"Until the person receiving the product is responsible in some fashion for the costs, there will be no incentive to spend responsibly"

Scott Serota
CEO, BCBS Association of Chicago
Chief Executive Magazine, March 2007 p. 50

After a Short Stay in America, Michelangelo's David Returned to Europe



Annual Excess Healthcare Costs Related to Consumer Behavior



Source: RTI International & Center for Disease Control and Prevention (200), Datamonitor (2007), Americas Health Insurance Plans (2007), Commonwealth Fund (2007), Agency for Health Research and Quality (2003), Analysis by PricewaterhouseCoopers' Health Research

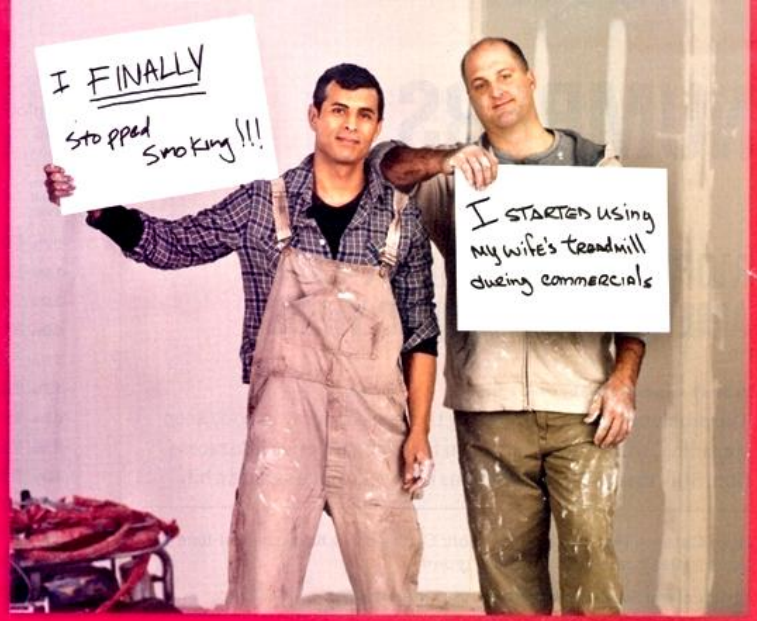
Personalized Medicine: Consumer-Centric Healthcare: A Key Driver

- clinical and economic benefits of coordinated care of complex chronic conditions
- cost-shifting to consumers
- cost-driven transitions from ‘passive patient’ to ‘engaged consumer’
- lifestyle and disease risk mitigation
- new information intermediaries

Personalized Medicine: A Broader Perspective

Wellness:

- economic and societal pressures for increased consumer responsibility for wellness
- remote monitoring of individual health status
- crucial role of healthcare information systems
  - integrated Rx care for complex chronic conditions
  - outcomes metrics and comparative effectiveness
  - earlier detection of disease episodes and risk mitigation
- wellness versus illness



No two employees are alike. And neither are their health decisions.

Your employees' decisions impact not only *their* health, but also your company's costs and productivity. To enable better decisions, UnitedHealthcare is leading the way with personalized health care solutions designed to help people – and businesses – stay healthy.

- Personal health assessments
- Personal wellness programs/tracking
- Personal care consultants
- Personal care plans
- Personal doctor selection
- Personal cost estimators
- Personal health records
- And more

Personalization is the heart of health care.℠ Better decisions lead to better results.

Find out how we can personalize your employees' health care to help your bottom line.

1.877.232.8821

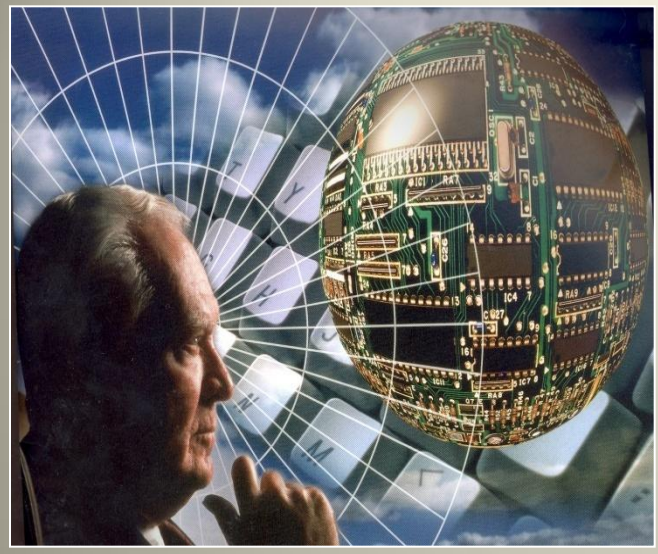
uhctogether.com/bizweek
Or contact your broker.

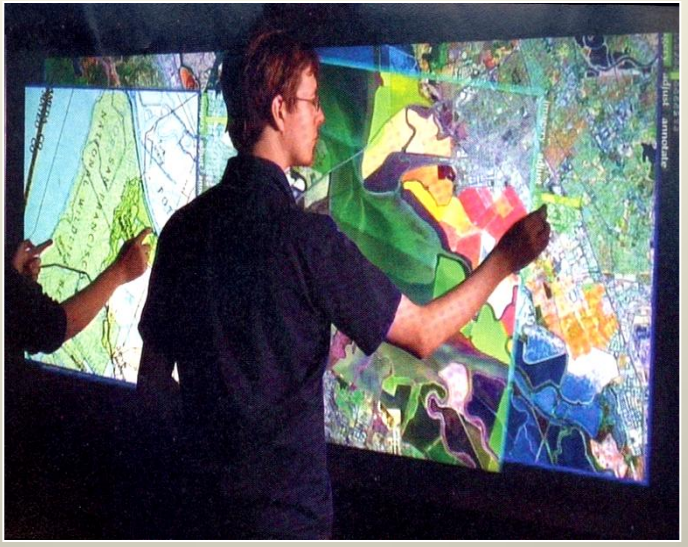
UnitedHealthcare®
Healing health care. Together.®

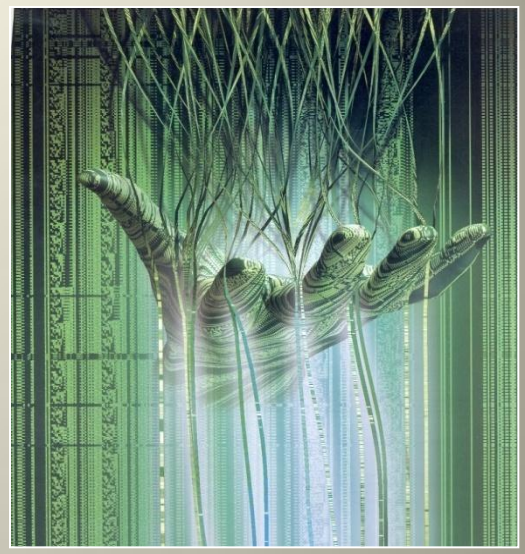
© 2009 United HealthCare Services, Inc. Insurance coverage provided by or through UnitedHealthcare Insurance Company or its affiliates. Administrative services provided by UnitedHealthcare Insurance Company, United HealthCare Services, Inc. or their affiliates. Health Plan coverage provided by or through a UnitedHealthcare Company. UHCEW423504-000

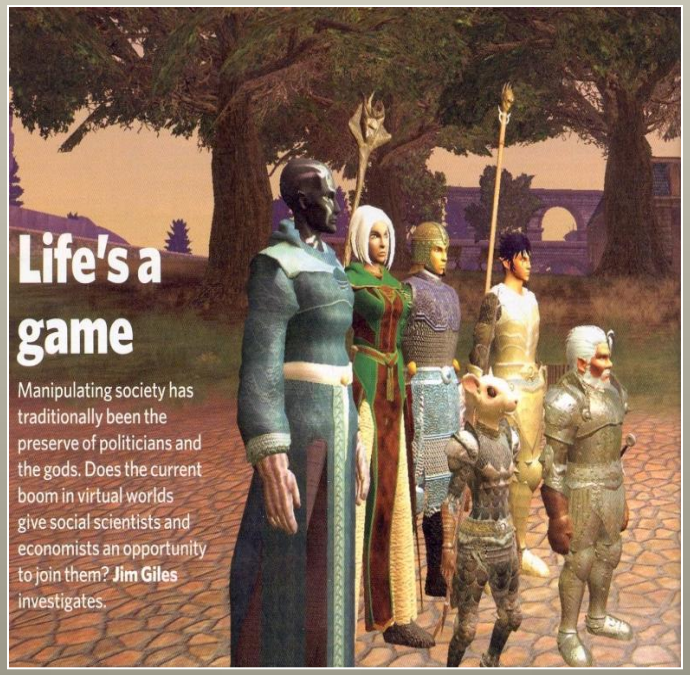
Telecommunications and Media Industry Convergence: Implications for Healthcare

The Infocosm: Emerging Networks of Global Connectivity



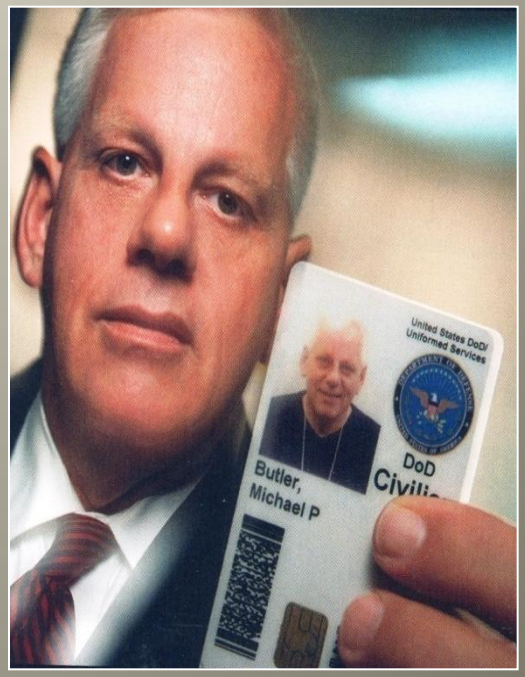






Life's a game

Manipulating society has traditionally been the preserve of politicians and the gods. Does the current boom in virtual worlds give social scientists and economists an opportunity to join them? **Jim Giles** investigates.



The Changing Nature of Social Interaction

Herd Behavior: 1951

1.3 Million Bathers, Coney Island, NY

Herd Behavior: 2008

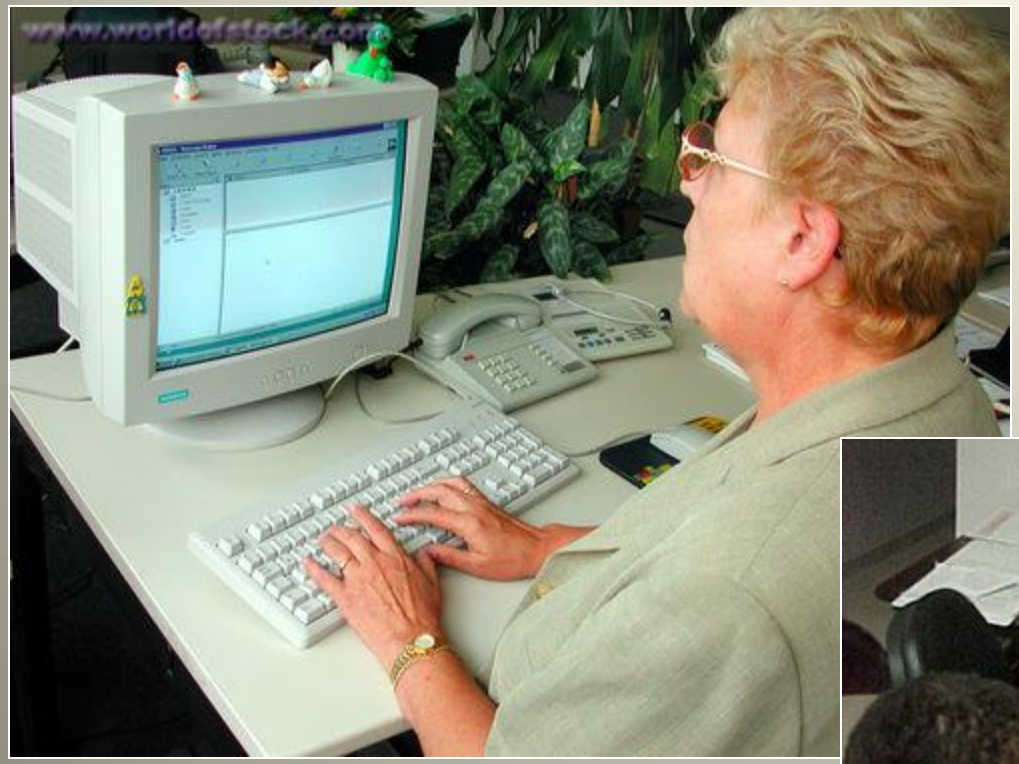
Social Networks and Virtual Communities

Consumer-Directed Healthcare: The Wellness Premium

- leveraging social and peer networks
- increased role of fitness industry and entertainment in healthcare
  - "success via distraction"
- "virtual touch"
  - web-based consultation and diagnostic algorithms
  - emerging generational gap in need for direct physical interaction with physician
- evolution of 'near-patient' health status profiling
  - POC and in-home Dx
  - OBIBs

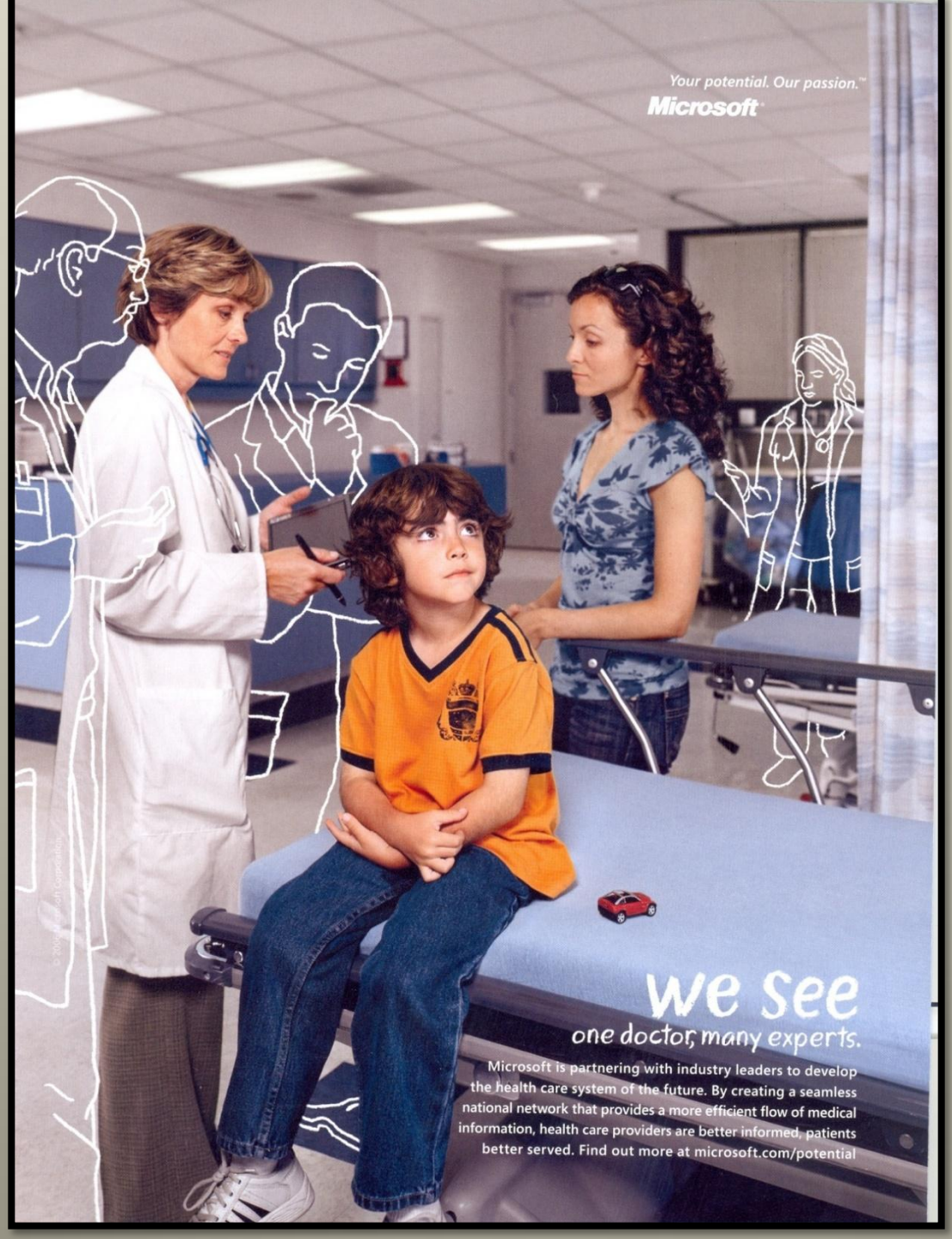
In-Home POC Health Status and Compliance Monitoring

In-Home Health Connection: Engaging the Elderly



Healthcare Information Networks: AORTA: Always On Real Time Access

- comprehensive connectivity
  plus
- collapsing time
  plus
- global networks


Your potential. Our passion.™
Microsoft
we see
one doctor, many experts.
Microsoft is partnering with industry leaders to develop the health care system of the future. By creating a seamless national network that provides a more efficient flow of medical information, health care providers are better informed, patients better served. Find out more at microsoft.com/potential

Deloitte.

Connected Care

Technology-enabled Care at Home

Produced by the
Deloitte Center
for Health Solutions

Audit. Tax. Consulting. Financial Advisory.

State of Technology in Aging Services According to Field Experts and Thought Leaders

By:
Majd Alwan, Ph.D.,
Center for Aging Services Technologies (CAST)
American Association of Homes and Services for the Aging (AAHSA)

and

Jeremy Nobel, M.D., M.P.H,
Harvard School of Public Health

Report Submitted to: Blue Shield of California Foundation

February 2008

cast™
Center for Aging Services Technologies

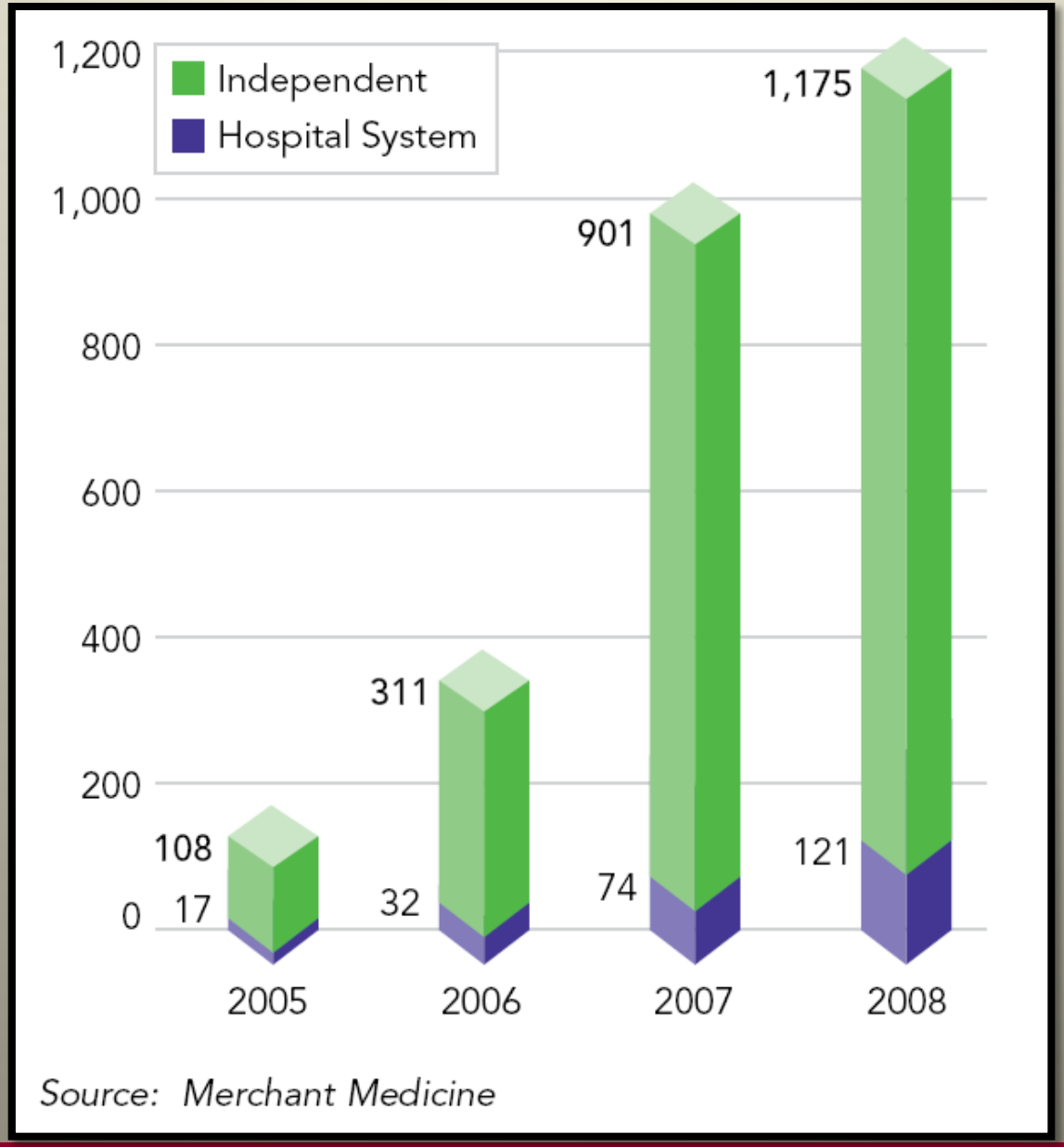
The Dominant Future Element in Primary Healthcare Delivery???

Walgreens
As far as you want to go.™

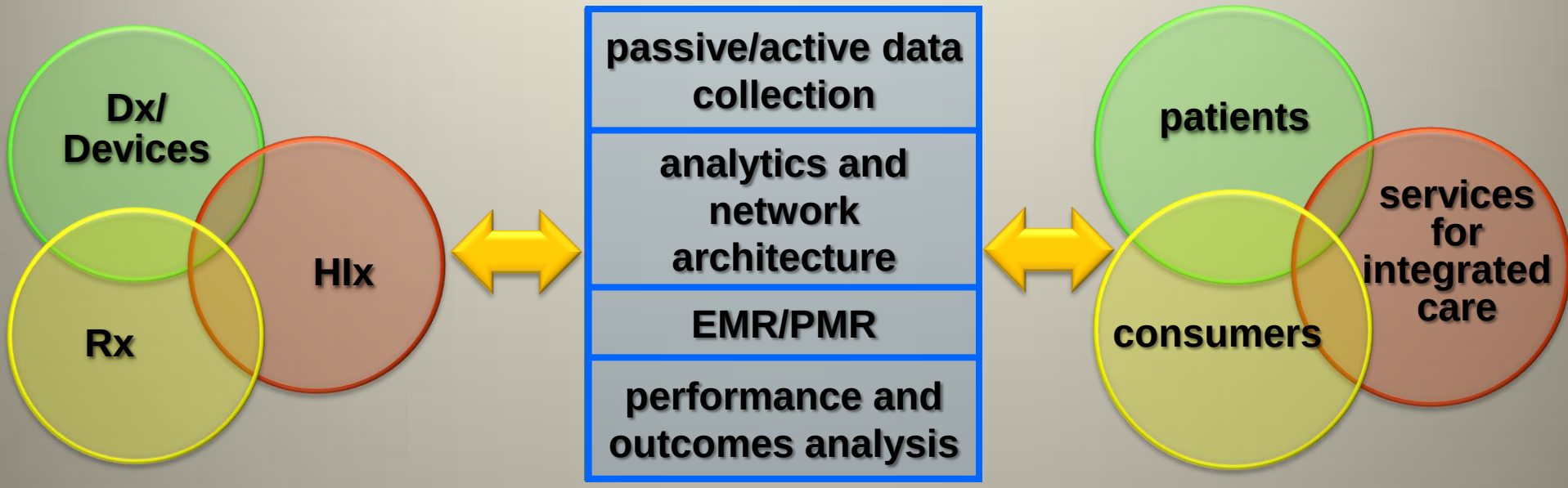
CVS CAREMARK

WAL★MART®
Save money. Live better.™

Retail Clinics Growth



A New Healthcare Ecosystem Arising From Technology and Market Convergence



Integrated Technology Platforms

Data Mining and Integration Services

Increasingly Targeted Care and Efficient Use of Finite Resources

From Ambiguity to Certainty: Competitive Superiority via Analysis of a Burgeoning Infocosm

- new intermediaries for analysis/packaging of healthcare data
- global sourcing of data and expertise
- lower transactional costs
- higher efficiency in use of expensive, finite resources
- increasingly predictable cost structure and predictable performance of products and procedures
- improved clinical and economic outcomes

Personalized Medicine: Progressive Evolution Based on Increasingly Comprehensive Profiling of Disease Risk and Health Status

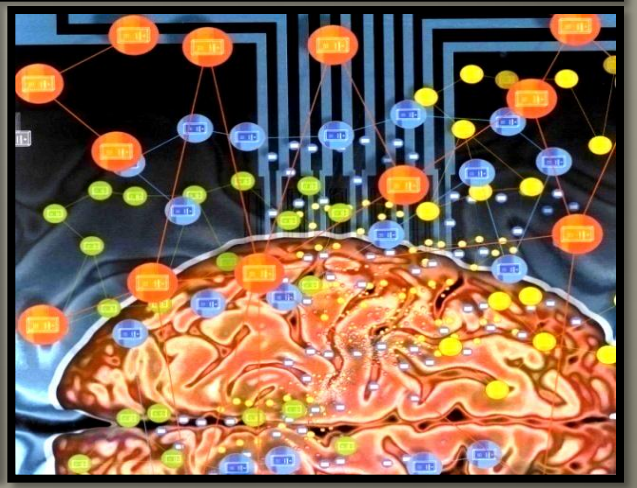
- rational Rx based on profiling of underlying molecular pathology
- MDx and disease subtyping

- rational Rx based on comprehensive molecular profiling of individuals
  - disease subtypes and optimum Rx
  - Rx AE risk
  - disease predisposition risk and mitigation
- integrated framework of longitudinal data on individual health status
- real time remote health status monitoring
- transition to disease prediction and preemption

“Managing Mega-Data”

volume

scale

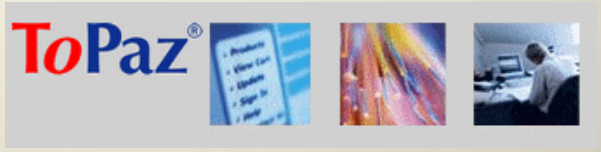


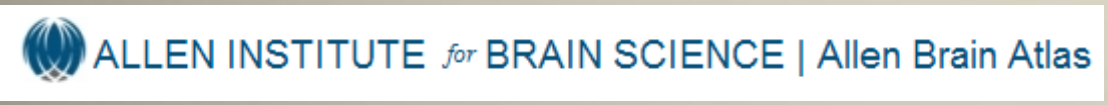
Visualization and Collaboratories

Data Heterogeneity, Mining and Context Formatting

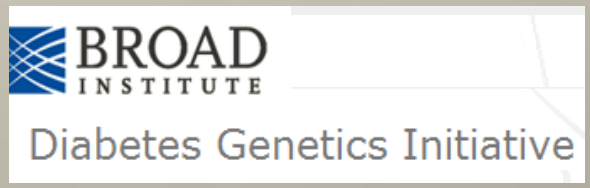
Cognitive Systems Biology and Optimum Decisions

The Rise of Open-Source Networks and Consortia



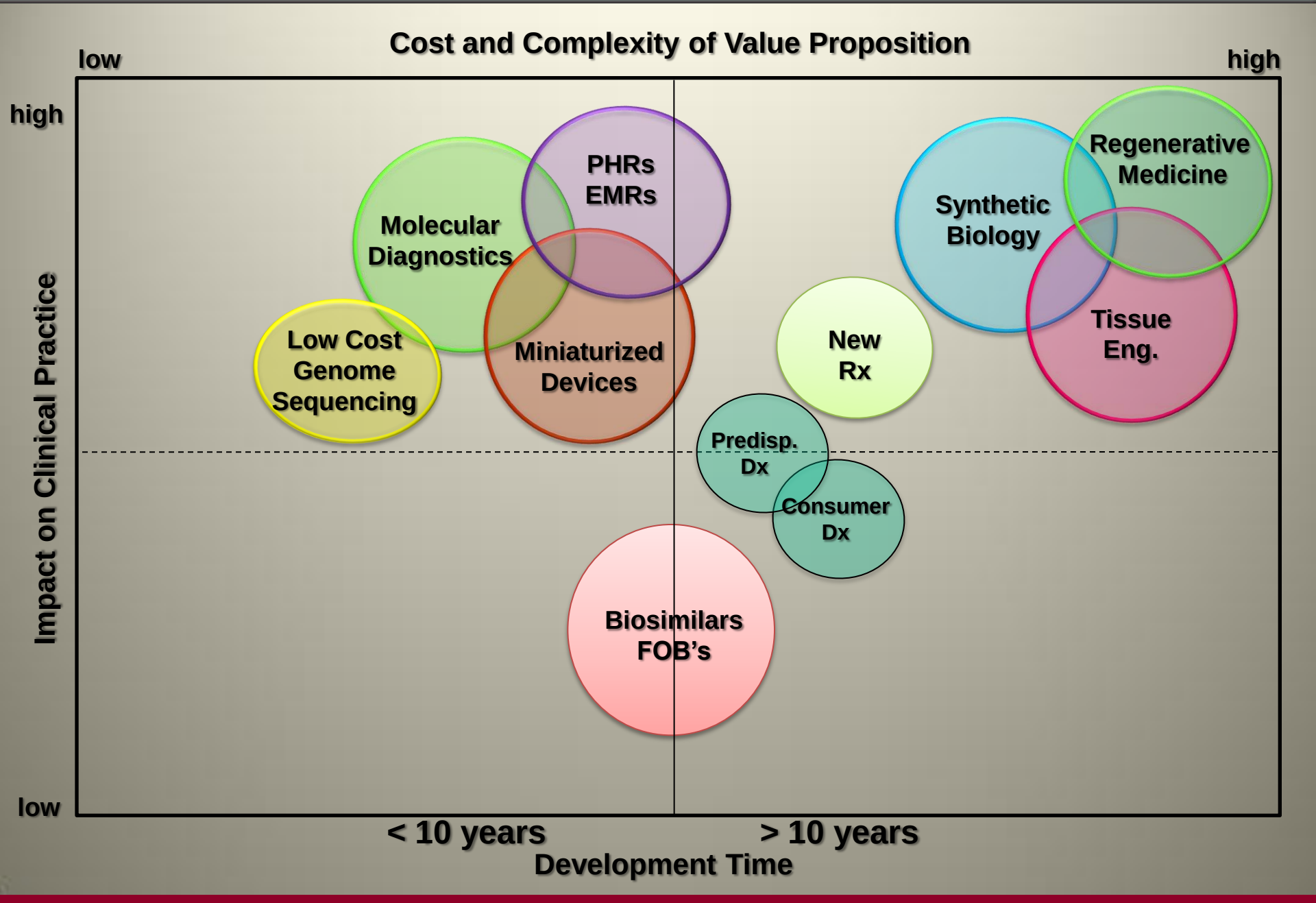


FDA/Severe Adverse Events (SAE) Consortium

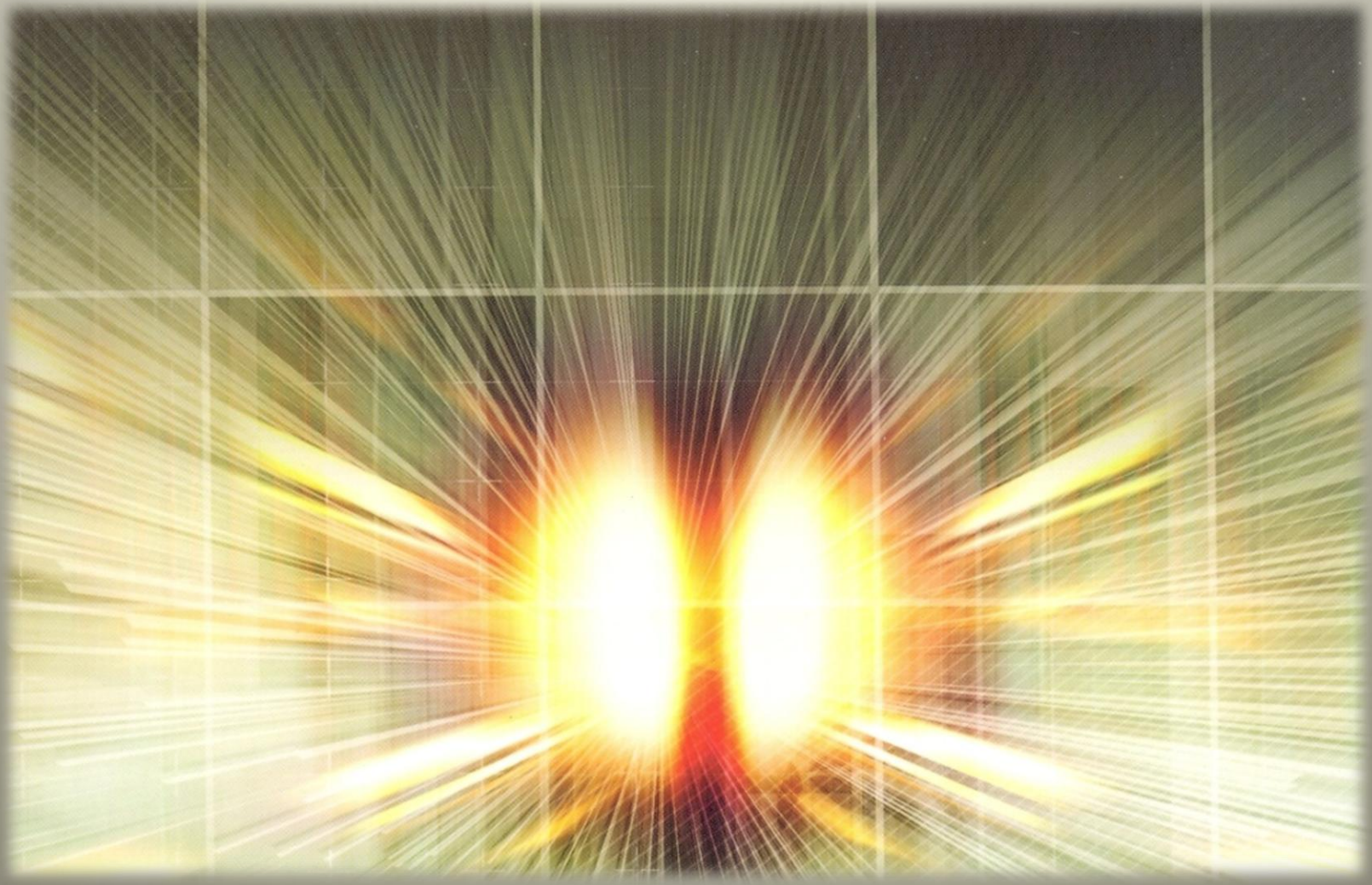


Clinical Semantics Group

A Technology Roadmap for Healthcare



The Coming Convergence in Healthcare Delivery



The Coming Convergence in Healthcare Delivery

Technologies

- biotechnology, medicine, engineering, computing

Clinical Practice

- molecular medicine and increasingly customized care
- diagnostic, drug and device combinations
- POC testing and remote monitoring
- reduced error and improved compliance
- improved clinical and economic outcomes

Realigned Incentives

- integrated care for complex chronic diseases
- earlier disease detection and risk reduction
- wellness versus illness
- health status monitoring

The Coming Convergence in Healthcare Delivery

Consumers

- increased personal responsibility for health
- new incentives for wellness/compliance
- health status monitoring

Connectivity

- integrated care networks for chronic disease
- improved outcomes and effectiveness
- social networks and informed consumers
- new supplier networks of specialized turnkey expertise
- value added ‘content’ services for clinical data mining

Creating a New Network of Connected Expertise to Accelerate Innovation in Healthcare R&D

- ever faster generation of new information
- diversification of innovation sources
- current R&D ecosystem is too fragmented to fully leverage novel content and shared learning
- global sourcing
- rise of new business models of ‘expertise networks’ that eclipse current monolithic single company innovation models

Building an Integrated Framework for Proficient Healthcare Delivery